Devoted to the Generation, Distribution and Utilization of Energy

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IRRIGATION DIVISION FEB 28 1917

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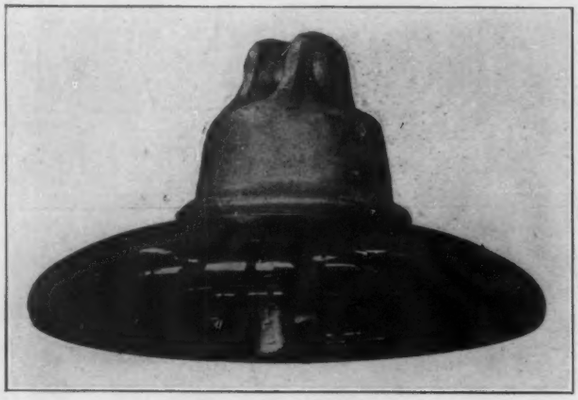

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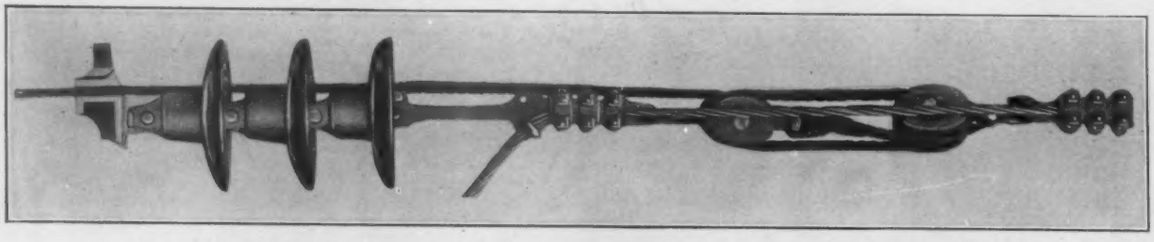

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THE CONSTANT ANGLE ARCH DAM

BY L. R. JORGENSON.

(The huge Spaulding dam of the Pacific Gas & Electric Company, now raised to a height of 280 ft. above its foundation bottom, is not only of intense interest due to its mammoth proportions, but it also represents a new departure in engineering design by the utilization of the constant angle arch feature. This evolution in design has been created by an engineer of the West and the perusal of the theory involved as set forth in this article will undoubtedly call forth unusual attention from our readers.—The Editor.)

Two arch dams have been built recently in the western part of the United States, to which more than ordinary interest is attached, on account of several new features introduced for the first time in the design. These features accomplish a double purpose. They introduce great economy and they also make it possible for the arch to take the greatest portion of the load acting as an arch even close to the foundation.

So far the greatest objection of engineers to the use of a pure arch dam has been, that as ordinarily built, it cannot deflect enough at and near the bottom, to take the load on the arch. As most of the load at the bottom has to be taken up by sheer action and cantilever action, material sufficient for this purpose must be provided. In the new type of arch the length of the upstream radius decreases at a more or less uniform rate from the crest towards the foundation. In the ordinary type of arch dam this length is kept constant or in case the upstream face is provided with a batter, this length increases from the crest towards the foundation. That this difference in the length of the upstream radii of the two types has an important bearing upon the economies of the design should be easily realized, when it is considered that the thickness of the arch dam section is proportional to the length of the upstream radius at any elevation and that the crown deflection is practically proportional to the square of the length of the upstream radius. Therefore, the smaller the length of the upstream radius, the smaller the required thickness and the arch deflection. This is of especial importance towards the bottom of an arch dam.

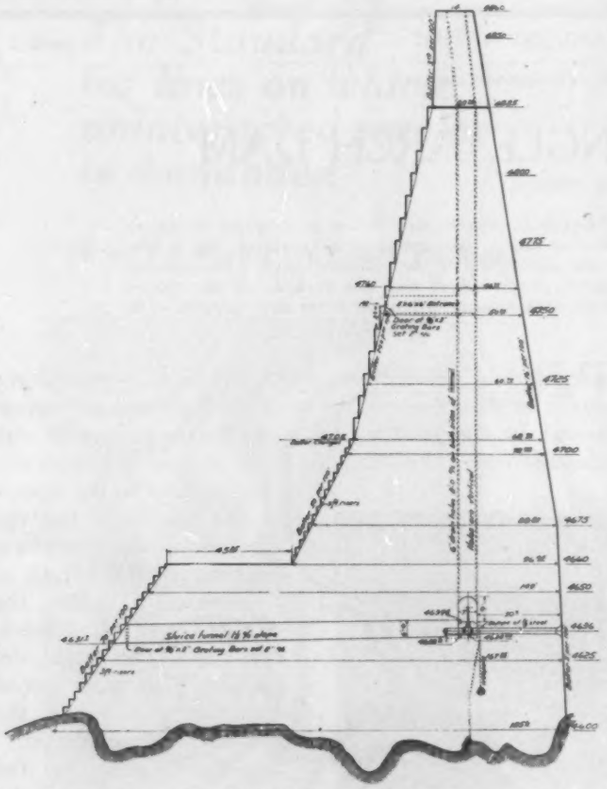
The Giant Spaulding Dam of the Constant Angle Type Recently Raised to 280 ft. Elevation.

Before taking up the description of the particular dams, already referred to, the general calculation of arch dams will be given with especial reference to this new type.

In order to obtain a preliminary dam section for any given dam site the simple formula $t = \frac{P \times R_u}{q}$ (1) can be used for finding the thickness of a sufficient number of arch slices at different elevations, and by superimposing these slices upon each other the dam section can be formed. In this formula **t** equals the thickness of the dam in feet at any given elevation; **P** equals the water pressure in pounds per sq. ft.; **Ru** equals the length of the upstream radius in feet, and **q** equals the

average stress in pounds per square foot of the area of the dam section. See Fig. 1.

From formula (1) it is seen that the thickness and therefore the area of the dam section varies in direct proportion with the radius. The volume of concrete in any arch dam is equal to the area of the section times the length of the mean arch. The length of the mean arch can be expressed as the length of the mean radius times the subtended angle in terms of π or $\mathbf{V} = \text{Area} \times \mathbf{R}_m \times 2\Theta$ (2) where 2Θ is the subtended angle.



Profile of the Spaulding Dam at Its Maximum Cross-Section.

The mean radius $\mathbf{R}_m$ equals half the width $\mathbf{W}$ of the span divided by the sine of half the subtended angle.

Fig. 1. Thus $$\mathbf{R}_m = \frac{\frac{1}{2}\mathbf{W}}{\sin\Theta} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

As the area of the section is proportional to the radius (both to Ru and Rm), formula (2) for the volume of masonry can be expressed thus:

$$\mathbf{V} = \mathbf{C} \times \frac{(\frac{1}{2}\mathbf{W})^2 \times 2\Theta}{\sin^2\Theta} = \frac{\mathbf{K} \times \Theta}{\sin^2\Theta} \quad \ldots\ldots (4)$$

where **C** and **K** are constants, the latter depending upon the width of the canyon.

According to equation (4) the volume varies with the term $\frac{\Theta}{\sin^2\Theta}$. The differential coefficient of this term equated to zero gives the minimum for a central angle of 133 deg., which means that any horizontal slice of the dam has the least volume when $2\Theta = 133$ deg. In other words the dam contains a minimum amount of material when the central angle is kept 133 deg. at all elevations.

The curve in Fig. 2 shows this graphically. The abscissas represent the central angle 2Θ and the ordinates represent the term $\frac{\Theta}{\sin^2\Theta}$, the latter being proportional to the volume of masonry. In addition to showing the point of maximum economy, this curve also shows that as long as the subtended angle is kept above 110 deg. the variation in the amount of masonry is very small, but below 110 deg. the volume increases rapidly. Most dam sites are narrower at the bottom than they are at the crest elevation, therefore in order to place the material in the dam most economically, it is necessary to change the length of the mean radius of the dam continuously from the bottom to the top corresponding to the change in width of the site, so as to keep the subtended central angle constant. In practice it is seldom possible to keep this angle exactly constant, but one should try to bring practice as close to theory as possible in designing the arch.

To prevent upper portions of the dam from overhanging the lower portion, it will be necessary to have the thickness of the section increase from the crest towards the foundation. The proportional increase in water pressure must therefore be greater than the proportional decrease in length of the upstream radius towards the foundation. The ratio of increase in water pressure is always fixed, and the ratio of decrease in the length of the upstream radius depends upon the slope of the canyon sides. If these slopes are such, that at any intermediate elevation the ratio of decrease in length of the upstream radius has been greater than the ratio of increase in water pressure, a decrease in thickness of the dam at this elevation would result, and the structure would be overhanging, which is impractical. A small overhang at the abutments only is, however, permissible.

Whenever a certain thickness must be provided to prevent too much overhanging, it is most economical to increase the length of the mean radius above that corresponding to a central angle of 133 deg. for the reason that a flat arch requires less material than a more curved one of the same thickness.

In the foregoing, the thickness of different arch slices at different elevations have been determined (from formula 1) as if all the load were taken by the arch and the dam had no gravity action. How safe a dam would result depends primarily upon the unit compression allowed when using formula (1) for finding the thickness at different elevations. This design however would in most cases prove to be weakest in the middle, for the same reason that a long column held at both ends is weakest in the middle and on account of having highest cantilever stresses here. Whenever **t** is small compared with **Ru**, the arch when loaded is practically a long column in compression, and the length of the arch should therefore not be over twenty-five times its thickness if the material is to be highly stressed. It is true that this circular column is supported to some extent along one side, but this added stiffness may be largely offset by the fact that the

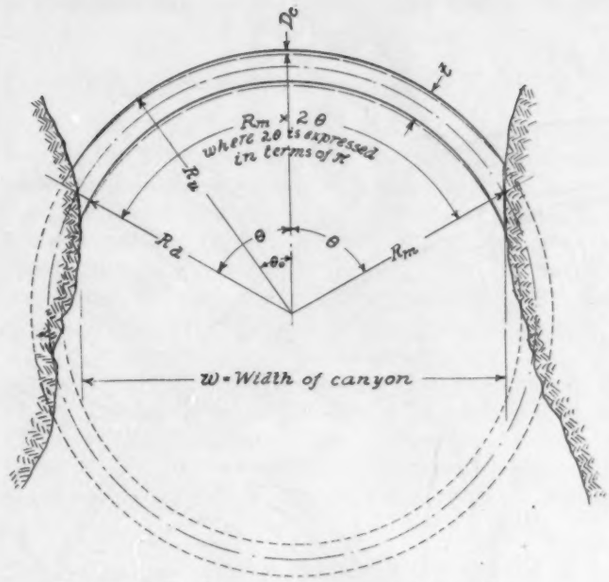


Fig. 1. Fundamental Theory of Stress Action

water may not soak through the upstream face uniformly, that is, the effect of the water pressure would, in all probability, be unsymmetrical about the center line of the dam. On a high comparatively thin arch dam section, the resulting compression due to cantilever action and weight of material above may become excessive near the foundation, requiring some additional material along the down stream face towards the foundation. The thickness of this added material should decrease vertically from a maximum at the foundation to zero at some higher elevation and horizontally from a maximum in the middle, or the point where the deflection is a maximum towards the abutments. The thickening of the dam in the middle to take care of cantilever stress also stiffens the arch materially, considering it as a curved beam. It acts as such to a large extent towards the foundation where **t** is large compared with **Ru**.

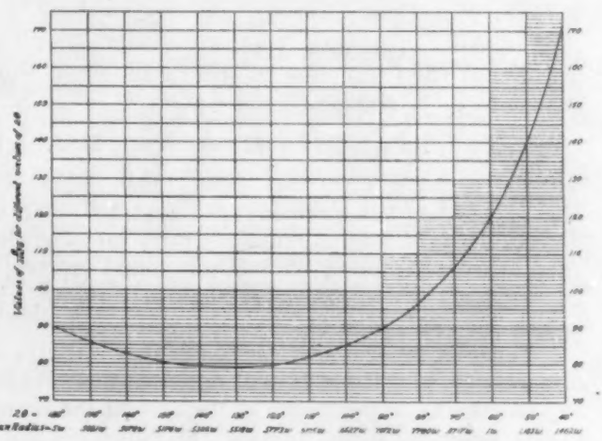


Fig. 2. Curve of Constants for Arch Design.

Before attempting to find what proportion of the load is carried by the arch and what proportion is carried by the cantilever it must be determined how much of the total load is carried by the initial stresses in the arch.

By initial stresses are meant stresses principally due to the weight of the structure and to the water pressure. Therefore these stresses reach their maximum values at or near the foundation and are zero at the crest. They have so far not been much discussed, but are very important and should be taken into consideration, when attempting to find the actual division of load between arch and cantilever. When a body is compressed the dimension in the direction of the compressive force becomes smaller, but in other directions the body swells if free to move (lateral strain).

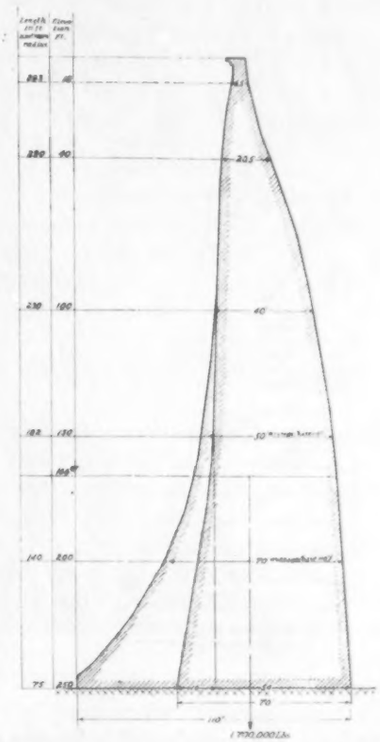


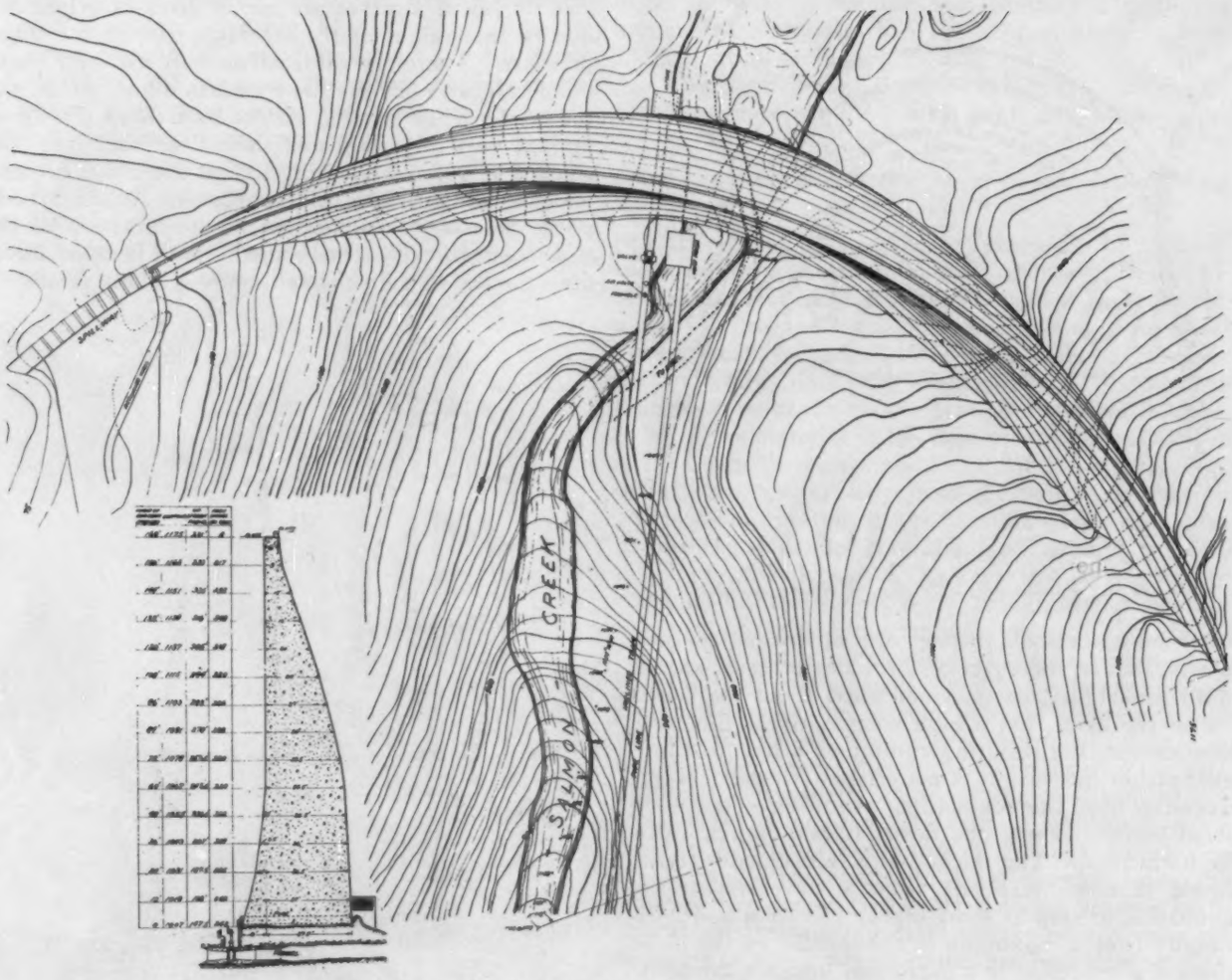
Fig. 3. Profile Section of Dam of 250 ft. Height.

Any horizontal layer of material* will have to sustain compression corresponding to the height of masonry above it and will therefore actually become shorter in a vertical direction and have a tendency to expend horizontally. If the abutments are unyielding the arch may be prevented from actually becoming longer, in which case axial compression is introduced the same as if water pressure acted upon the structure.

If the specific gravity of the concrete for the dam is taken at 2.3 and the height of the dam **H**, then the average vertical pressure can be expressed as $\frac{2.3\,H}{a}$

where **a** is the ratio of total height of dam to height of a rectangular wall having the same sectional area

*The ratio of lateral to longitudinal strain for concrete has been taken $1/m = 1/5$ in the following calculations. Professor C. von Bach has been kind enough to make some tests for the writer to determine **m** for concrete 1:2:3. He found for specimens 45 days old, using between 0.1 and 24 kg/q cm compression, **m** to be 5.3; see also Bach's Elastizitat and Festigkeit 5 Auflage Seite 301. Considering that large stone will be embedded in the concrete in most dams the factor 5 has been used for **m** as probably representing most closely actual conditions.



Constant Angle Dam Constructed on Salmon Creek In Alaska, showing Plan and Profile.

and the same base. The ratio "**a**" is known as soon as the section is known, and in dam design the section must be more or less determined before final calculation can be made.

The dam section shown in Fig. 3 has an area of 9668 ft., a base width of 70 ft. and a height of 250 ft. The height of masonry column causing the mean vertical pressure is therefore $\frac{9668}{70} = 138$ ft. and $\mathbf{a} = \frac{250}{138} = 1.81$, making the mean vertical compression upon the foundation in terms of head of water equal $\frac{2.3\,\mathbf{H}}{1.81} = 1.27\,\mathbf{H}$ with no water pressure upon the upstream side.

The condition of reservoir full introduces an additional force—the radial water pressure—tending to compress the dam body in a direction perpendicular to the direction of the compressive force due to the weight of the body. At the bottom of the dam this force is equal to **H** in case the water is standing to the crest of the dam. In this case the radial water pressure tends to counteract the swelling of concrete in an up and down stream direction (due to the weight) thereby introducing additional initial axial compression. The total resulting initial axial compression at the foundation of section shown in Fig. 3 is therefore (in terms of head water):

$$1/5 \times (1.27\,\mathbf{H} + \mathbf{H}) = 0.454 \times \mathbf{H} \ldots\ldots (5)$$

where Poisson's ratio has been taken equal 1/5. Mr. H. Ballet was probably the first to point out the necessity of taking Poisson's ratio into consideration when attempting to find the actual stresses in a dam body, Proceedings of the Institute of Civil Engineers, 1909, page 51.

The height of water "**h**" that this initial axial compression of $0.454 \times \mathbf{H}$ will resist without causing any shortening of the length of the arch at the bottom can be found by using formula (1) thus:

$$\mathbf{h} = 0.454 \times \mathbf{H}\frac{\mathbf{t}}{\mathbf{Ru}} \ldots\ldots\ldots\ldots (6)$$

For the narrower section shown in Fig. 3, $\mathbf{t} = 70$ ft. at the base $\mathbf{Ru} = 75$ ft. Substituting these values it

is seen that this section at the very bottom is able to carry $h = 0.454 \times H \times \frac{70}{75} = 0.425\,H$ or 42.5 per cent of the total head of water as an arch before any shortening in the length of the arch occurs.

The initial axial compression holds in equilibrium the stresses due to 42.5 per cent of the total head at the bottom the remaining 57.5 per cent of the load will divide between cantilever arch and curved beam action in proportion to their relative carrying capacity.

By analyzing equation (6) it is seen that by simply varying **t** or **Ru** or both, the designer can utilize more or less of the initial stress to carry the load. If the base thickness in Fig. 3 is increased from 70 ft. to 110 ft. and the thickness increased correspondingly at higher elevations, the initial stresses will be able to sup rt at the foundation $0.4 \times H \times \frac{110}{75}$ $= 0.585 \times H$ or 58.5 per cent of the total water pressure before any shortening in the length of the arch occurs and before additional axial compression is introduced.

When the arch, however, becomes very thick in comparison with its length, the load is carried more by curved beam than by ordinary arch action.

The dam shown in Fig. 3 was designed with varying radii to keep the central angle of the arch as nearly constant as possible at all elevations. For comparison, a section is shown in Fig. 4 using the same unit compression except where the section is wider than a gravity section near the foundation and the same upstream face batter, but a single common center as ordinarily used for both upstream and downstream faces. For this section the length of the upstream radius is also variable, but it increases towards the bottom and reaches here a value of 322 ft., see tables of lengths of the respective figure. The initial stresses in this dam will resist 20 per cent of the head of the water at the bottom. It is therefore easily seen that the constant angle arch is much more effective in utilizing the initial stresses to carry the load, than is the ordinary arch dam struck from a single center. If a gravity section is insisted upon for the arch, but the central angle kept as near constant as practicable it will be possible for the gravity section to take up the greater part of the load acting as an arch and curved beam. The factor of safety has thereby been largely increased.

For finding the arch deflection the following formula has been used:

$$D_c = \frac{C C_c \times P_1 \text{ (upstream radius)}^2}{\text{Ext.}} \quad \ldots\ldots\ldots (7)$$

where $P_1 = P \times \frac{Ru}{Rm}$ and $C C_c$ is a factor which takes the curved beam action* into consideration and can be directly found from Fig. 5. **E** is the modulus of elasticity and **t** is the thickness.

Formula (7) has been used for finding the deflection curves **A** and **B** (Fig. 6) of the two sections Fig. 3 (base 110 ft.) and Fig. 4.

Formula 6 has been used for correcting these curves **A** and **B** to take the effect of lateral strain into consideration. These curves represent the deflection of the two arches assuming they are free to move at the foundation. They are plotted to show how evenly the deflection, curve **A**, slants from a maximum near the top to nearly nothing at the bottom in the constant angle arch type Fig. 3 and how little the slant curve **B** amounts to in the ordinary type of arch dam Fig. 4. These curves also show very plainly that from the common arch type much arch action towards the bottom cannot be expected, cantilever and beam action must take the load since no such deflection as 0.2624″ could be possible at the point where the arch is fastened to the rock foundation. The constant angle arch type for this particular site requiring only 0.0083″ deflection, 31.5 times less to support the same load will take most of the load upon itself acting as an arch.

The foregoing method of calculation does not hold true for carelessly constructed dams. On such structures the initial stress can not be expected to assist the stability of the arch. For carefully constructed dams, the theory should hold true, and the possibility even exists of constructing the dam such that the actual stress will be more uniformly distributed than the formulas would indicate. This can be accomplished by using many plumstones in the concrete along the upstream face and few or none along the downstream face, thereby making the shrinkage due to settling less along the upstream face, and also making the modulus of elasticity higher along this face, both these conditions tending to effect a transfer of stresses from the downstream face towards the upstream face, and also tending to lessen the maximum cantilever compression at the downstream toe.

The fact that the water load is not thrown on the structure in an instant, also tends to affect a more uniform distribution of the stresses. Generally weeks or months are required to fill up a reservoir, and during this time interval the modulus of elasticity of the concrete has had time to adjust itself according to the different amount of stress thrown on different portions. Due to the action of the time factor*—for concrete only,—parts highly stressed, such as the toe of high dams, deform much more than in proportion to the load carried, and therefore, as the concrete yields, load is transferred to some other place of lower stress, thereby relieving the most highly stressed part. An important arch dam should not be closed during the hottest season, but should be built up in alternate sections and closed during the colder part of the season, and it should not be built too fast. Careful construction is more important than the use of low stresses in the design.

SHORT JOURNEYS IN PACIFIC LANDS

(South America constantly appeals to engineers of the West as a possible field of future activity. Descriptions of the country and the customs of the people are of great practical aid to engineers when making journeys into countries bordering the Pacific. Below may be found some of the interesting experiences encountered by an American engineer who was formerly engaged in hydroelectric installation in Peru.—The Editor.)

A Native Peruvian Town, at Elevation 13,500 ft.

The Highest Railroad in the World, at Elevation 15,685 ft.

Water Diverted from Amazon for Hydroelectric Power.

AN AMERICAN ENGINEER'S EXPERIENCES IN PERU.

The water of the Yauli River was diverted about one mile below the little town of Pachachaca by means of a dam and carried along the hillside in canals or through tunnels and pipe lines to Oroya, where the power house is built near the junction of the Mantaro River and the Yauli River. The first installation in this power house consisted of three 3000 kilowatt electric generators or a total of 12,000 h.p. This power is transmitted to the company's mines located on both sides of the power house, and also to the copper smelter, where electric motors substitute the former steam equipment. The total fall or head of water at the power house is 730 ft., and the maximum distance from the plant to which power is transmitted is 100 miles, the operating voltage being 50,000.

In traveling along these rivers I had occasion to become quite familiar with the country. The hills contain, or are supposed to contain many minerals, and some of them are being taken out by big companies. This is not a proposition for a poor man to tackle, as it requires large investments before any returns are possible, larger than in other places on account of the inaccessibility of location.

Agriculture is evidently a poor business on account of the high altitude, where only enough wild grass can grow to support sheep, mules, llamas and a few other native animals. I do not understand why the Indians living up on the hills do not move lower down in the valleys where they can raise something. They seem, however, to be able to just make an existence with very little effort, and evidently that is satisfactory to them. The many ruins of what were former cities and towns located on the very top of the mountains were an indication that the country was much more populated in these places in former years. Also the fact that even the hillsides had been terraced off and farmed, and some of them are being farmed today, is very interesting. It is incomprehensible how the people were supplied with water on the very top of the mountains.

I was astonished to find that ordinary animals, such as pigs, horses, etc., do not multiply up in this high altitude. While they can live there, they lose the power of propagation and a new supply must be brought up from below from time to time. There were no fish in any of the streams, probably due to the absence of insect life. The chickens lay eggs but they do not hatch. All this goes to show that it is not only mankind that the atmosphere affects. The absence of trees or growth of any description makes the place as desolate looking as a desert, and if it was not for the minerals in the hills, would not have any attraction.

The surveying of the hydraulic canal was very much facilitated by the absence of vegetation, there being nothing to obscure the views in any direction. The river below and the snow-clad mountains above were always in sight. As we went ahead we moved our camp which consisted of two tents, necessary food, blankets, etc. The cooking was done by an Indian, and although we had good oil stoves and oil and coal along, he kept on using the kind of fuel he was accustomed to, dried manure. He traded this from Indians in the neighborhood for the coal and oil we had along. The dwellings of the Indians along the stretches we traveled were primitive and I do not see how they managed to keep warm as the temperature is low considering this place is but 12 deg. south of the equator. It generally freezes at night and in the day time the thermometer seldom gets much above 60 deg. fahrenheit.

I stayed one day and night with a family in one of those casa's because I had to. Missing an ore train which we were supposed to stop and ride on to a certain place, the party had no choice of what to do for the night as we had no tent and it is too cold and dangerous to sleep out in the open at that altitude. There were only Indians around so we put up in an Indian mansion for the night. The family consisted of a couple of men and a couple or women, some "tame" pigs and chickens. One of the ladies prepared the dinner, which consisted chiefly of a piece of sheep

meat which had been laying outside on the rocks to dry for quite a while. It made a hit with our Indian cook and our guide, also an Indian. I was well satisfied with a few raw eggs and some Lima Pilsner. Most of the family slept on the floor, the solid terra firma, of course. I was fortunate enough to get something that resembled a bed to lay on and was quite comfortable. Very luckily, all insect life is absent in this altitude.

Before a waterpower plant can be built a permit to divert and use the water must be obtained from the government. In this respect the Peruvian government is liberal, feeling that everyone who is willing to invest money in undertakings that will build up the country ought to be encouraged in trying to do so.

NOTATIONS FOR TELEPHONE INSTALLATIONS IN CHINA.

The police headquarters at Chungking recently received instructions from the Co-Director of Military Affairs of Szechuen Province to establish a small telephone system to connect the various government offices and police stations in this city. This system is being established to facilitate the transaction of official business and is not intended for the use of the public. Fifty telephones and their accessories have been ordered through a local firm from Shanghai. The instruments are said to be British and to cost 120 taels (about $91 United States currency), each. The service has been offered to the local consulates.

The regulations governing the installing of telephones prescribe that subscribers must deposit a cash bond of $50 Mexican (about $27 United States currency), which will be returned when the telephone is removed, and pay a monthly fee of $6 Mexican. The shortest term for which a phone will be installed is six months. This system is under the management of the police headquarters of Chungking. It has been arranged between the police headquarters and the telegraph administration that in the event of a service for the use of the general public being established, this system will be purchased by that administration.

The installation and operation of telephone services is a government enterprise and is reserved to the Ministry of Communications.

THE ELECTRICAL MAN'S RESPONSIBILITY TO HIS COUNTRY.

H. M. Byllesby addressed the Electric Club—Jovian League of Chicago, at its weekly luncheon December 28th, at the Hotel Sherman, on the above subject. A large audience applauded his remarks on the need of preparedness, in the course of which he said:

"If the perils to our country, now so ominously emerging, are overcome it will be because we citizens calmly and with spiritual uplift immediately consecrate ourselves to that service to the state which each of us are best able to discharge. In this rising to the defense of our beloved country, which has showered so many opportunities upon us, the electrical man must be, and naturally will be, a factor of the first importance. The electrical man has had an experience of unique value which he can place at the disposal of his country.

RECENT TESTS BY BUREAU OF STANDARDS.

Among the tests conducted recently by the United States Bureau of Standards as aids to the development of industrial methods were series relating to the construction of concrete columns and the production of insulating material.

Three tests were made of a special commercial insulating material to determine its fire-resisting properties. The material submitted by the manufacturers was intended for use in a number of instances to replace wood. The test specimens were about 18 by 18 inches and 6 inches thick. They were placed in a furnace as a panel, one of the larger faces being exposed to the heat of the furnace and the other to the atmosphere. Upon being heated to 950 deg. in 30 minutes and held at that temperature for four hours it was found that the temperature at a distance of 1½ inches from the heat-exposed surface was about 240 deg. C. At a depth of 5½ inches from the heat-exposed surface 66 deg. was the highest temperature recorded. One of the blocks after having been subjected to this heat for the period mentioned was quenched with water. The damage to the specimen that was quenched was found to be less than to an unquenched specimen. This is explained by the fact that the blocks contained considerable organic matter which tended to be disintegrated by the heat transmitted very slowly from the heated surface, even after the flame was removed from it.

The series of tests of concrete columns was partly in the nature of an investigation and partly in the nature of routine testing. These are the first columns of their kind to be tested in this country. The unique feature is a hollow cast-iron core. This is surrounded by concrete, reinforced with both spiral and vertical reinforcing. Such a column may be made very cheaply. Not many results have yet been obtained, but the tests are still in progress. It would appear, however, that the load which these columns can sustain is considerably in excess of that which can be borne by the ordinary reinforced concrete column of an equivalent cross section.

A NEW BOOK OF GEOGRAPHIC POSITIONS.

Bulletin 644 part E, just published by the United States Geological Survey of the Department of the Interior, gives latitudes and longitudes of primary traverse stations in Illinois, Wisconsin, Minnesota, North Dakota and South Dakota, for 1913-1915, inclusive.

This publication gives descriptions and geographic positions of 1870 points, such as road crossings and section and township corners, some of which are permanently marked by iron posts, 4 ft. in length, set firmly in the ground.

Such data as these are essential to map makers and are determined by the Geological Survey for the control of its topographic maps. The positions and distances given may also be used with advantage by land or mine surveyors for checking their work.

A copy of the bulletin will be sent post free to any one who is directly interested and will address a request to the Director of the Survey at Washington, D. C.

DISCUSSION ON ELECTRIC LOGGING.

Sir:—The paper on Electric vs. Steam Logging, read by Mr. W. D. Peaslee before the recent Pacific Coast Logging Congress at Portland, and printed in the November 18, 1916, issue of the Journal, has brought forth discussion among engineers of long practical experience in the Northwest.

This discussion is not offered in any spirit of criticism, but only for the purpose of getting before the readers of the Journal the views of a great many engineers who have not been convinced, as yet, that electric logging has been developed and perfected to such a state that on a cost basis it can compete with steam under the inherent conditions surrounding fir timber logging of the Northwest.

As Mr. Peaslee states in the opening paragraph of his paper that, "The first and most important final answer to the question as to which logging machine is most suited for a particular duty, is represented by the dollar mark." The following discussion will endeavor to point out wherein many engineers and loggers familiar with logging conditions in the Northwest do not agree with him.

On page 391 it is sstated "The following summary of costs per donkey is based on an installation of five machines."

Building 35 per cent of proportionate building cost	$1050.00
Power station on same basis	5330.00
Total	$6380.00

It would be necessary to furnish at least 350 kw. of capacity for each logging donkey and figuring at $65 per kw. for power station equipment and buildings, we have (for each one) $22,750 instead of $6380 as given by Mr. Peaslee. We understand that Mr. Peaslee's figures are for one donkey plant equipment instead of five as stated in his paper.

The next item:

Transmission line	$ 3,200.00
The minimum average length of transmission lines taking in consideration new and old camps, would be be a conservative estimate 10 mies and at a cost of	1,000.00
Per mile we get	10,000.00

Allowing Mr. Peaslee's price of $6550 for transformers and cables, we have a total cost of $39,300 instead of $16,130, based upon the installation of one logging donkey, instead of five.

Mr. Peaslee states that power costs are based upon 1.5 cents per kw. hour. Now let us figure out what the power company will receive when it offers power at this rate to a logging company.

If the donkey ran 30 days a month of 24 hours each at 1.5 cents = $10.20 per month and 12 months of the year = $122.40 per year per kw.

Logging donkeys, however, do not operate continuously, but vary intermittently. Average conditions are as follows:

10 hours per day = 5/12 of a day.
25 days per month = 5/6 of a month.
9 months per year = 3/4 of a year.

Therefore we have:

25/96 × $122.40 = $31.87 per year per kw. at 100 per cent power factor.

Thus, if the load factor equals one-third, the final revenue the power company will derive on peak load $10.62 per kw.

This does not appear as a very attractive proposition from a power company's standpoint and it is consequently very doubtful if power could be purchased for 1.5 cents per kw.-hr. for logging purposes under average conditions. Also the hard duty imposed upon the transmission line from a load of this character is not attractive even on general principles.

On page 392, in the fourth paragraph it is stated that an electric donkey will handle 25 per cent more logs in a given time than the steam donkey.

As there is no electric logging of fir timber being carried on at this date, any assumption of this kind is not based upon actual data and should be regarded as purely speculative.

On page 393 Mr. Peaslee states that cables might be bought on a guaranteed mileage basis, providing it was not strained beyond a certain point during the period of operation.

Because the operating conditions surrounding each "set-up" presents such a variation of rigging and soil conditions for abrasion of the cables, no cable manufacturer could sell cable on this basis.

If a cable was subjected to sharp bends or turns through blocks, it would have its life shortened materially no matter if it were not "strained."

Also, if the ground was sandy or rocky and badly broken up, the abrasion would be increased.

When logs are cut, they must be gotten out or "yarded," regardless of cables and safety devices.

Consequently it would be a very exceptional case when it would be practical to always operate without straining them.

On page 393 Mr. Peaslee says, "the possibility of electric shock from the donkey is very remote and entirely negligible, if all metal parts of the equipment are thoroughly grounded.

"Thorough grounding" under normal conditions would mean making the ground at a water source and would have to be of a very substantial and absolute nature.

During the dry season this might mean a ground line 1000 to 2000 ft. long, in order to reach a place with sufficient moisture for a permanent ground.

Also under logging conditions the ground wire would be always subject to all manner of disturbances—such as breaks from falling timber, etc.

F. D. WEBER.

PETROLEUM IN CENTRAL WYOMING.

The petroleum resources of central Wyoming have engaged the attention of many since the days of Captain Bonneville's travels in the last century, when he described for the first time some of the tar springs of that region. Definite information as to the situation of the rock folds that are favorable to the accumulation of oil in this region is given in a report just issued by the U. S. Geological Survey, Department of the Interior. This report contains an account of the oil-bearing formations in central Wyoming, and points out the formations most likely to contain petroleum, such as the Frontier, with its important Wall Creek and Peay sandstone members, which are the productive sands in the most noted commercial oil fields of Wyoming. The report describes more than 20 anticlinal folds and notes whether the prospects that they may contain petroleum are favorable or unfavorable.

Large sums have been spent in prospecting in this region, but much of it has been wasted in unlikely places, and it is believed that wells properly located would perhaps yield oil in commercial quantities. The places where the most promising oil sands are concealed in anticlinal folds are pointed out in the final discussion.

A copy of Bulletin 641-I, entitled "Anticlines in Central Wyoming," by C. J. Hares, will be sent free of charge on application to the Director of the U. S. Geological Survey, Washington, D. C.

BETTER OFFICE METHODS

(The telephone has grown to be indispensable in modern business and engineering practice. Herein are set forth some excellent pointers that every business and engineering firm may well ponder over in the selection of private operators. The author is Division Superintendent of Traffic for the Pacific Telephone & Telegraph Company at Portland, Oregon, and presented this paper before the recent bi-monthly luncheon of the joint local sections of the A. I. E. E. and N. E. L. A. with the Oregon Society of Engineers at Portland.—The Editor.)

Operating Room. Retiring Room. Lunch Room.

THE TELEPHONE OPERATOR AND HER WORK.

BY J. H. CORCORAN.

The subject I have elected to discuss is that of the Telephone Operator and Her Work, because, while associated with telephone companies for many years, I have been directly associated with the work of improving central office operating practices and methods, and the training and supervision of central office operators, for the past eight years.

As you are aware, the telephone and the telephone switchboard were not invented simultaneously. The first telephone consisted only of what we now term the "receiver," and when used, these were connected in pairs, that is, one receiver was placed on one end of the line and another receiver on the other end.

It became apparent with the additions to the private lines that some sort of a switching device was required so that one line could be connected with another. Telephone history, I believe, credits a Mr. Holmes, Jr., of Boston, with putting in use the first telephone switchboard. Mr. Holmes' father operated a burglar alarm system which had wires to the principal banks in the city, and young Holmes found that by putting a telephone on each of these circuits and tying the terminals of the burglar alarm circuits together with a piece of wire, the telephones would be connected. This, while a very crude arrangement, was really the birth of a new idea in the business world.

In a short time it was found that the switchboard used by the telegraph companies was adaptable for telephone use, and the first commercial switchboards were of this type. The usual plan of operation for the central office then was this: A switchboard of the telegraph type was built on one side of the room. On the other side of the room registers containing paper tape were placed. On the subscriber's premises was placed a telephone consisting of a receiver, a vibrating bell and a call box of the same type then and now used by messenger companies. To the subscriber's premises were built two lines; one, his telephone line, and the other, the circuit on which the call box was located, there being many of these call boxes on one circuit. To signal the central office, the subscriber pulled the lever on the call box. This caused the call to be recorded on the paper tape at the central office. A boy would read the record on the paper tape and call across the room to another boy to answer a particular subscriber. The boy operator would then take a cord and plug into the jack of this subscriber, and after obtaining the number would establish connection on the board.

In the larger offices, (and you must remember that there was no multiple in those days) the switchboards were from twenty-five to thirty feet long, and the cords were correspondingly as long. They were termed the "Cord and Reel" in those days, as the cord wound up on a reel by spring pressure.

It is certain that when several calls were being received about the same time, what with the calling of numbers across the room and the boys racing madly from one end of the board to another to complete these connections, that the central office was not a quiet restful place.

As the systems grew, the confusion became greater and greater, but in the meantime developments were being made in the switchboard; the carbon transmitter was being brought into use; and gradually the loud-voiced boy was being replaced by the soft-voiced, deft-fingered girl. It is true that in these earlier days, the girl operators did not receive any particular training. The boards were comparatively simple, and the calls were few. However, as the system grew, the need of training operators carefully for the work was apparent.

The telephone companies in the larger cities today provide well-equipped training schools for their

operating forces. An applicant for a position as operator has her eyesight tested, her enunciation noted, must have a good grammar school education, and must impress the school principal as being a person who will not discredit other members of the operating force.

After a girl has been accepted as a student—and I wish to call to your attention that in this city of Portland only one in six of all applicants are accepted in the operating school, and it must not be understood that every applicant graduates from the operating school, because even after acceptance, it may be found that some feature or mannerism renders the girl unfitted for telephone work—after a girl has been accepted as a student, she is placed in our training school for a four weeks' instruction in the handling of telephone calls. Remember that this four weeks is simply a preliminary training for the student. The schools are provided with competent instructors, are equipped with individual desks, with a standard multiple switchboard, and special apparatus so that the instructors can originate calls which the students will answer, and complete in the multiple board. A course of study is provided so that during eight hours of each working day of these four weeks the student is either engaged in handling calls originated by the instructors, is reading the explanation and instruction covering the handling of calls from her study books, or in class is listening to an instructor going over the details of the lessons they have been studying.

When the student graduates from the school—and she is not permitted to graduate until she is letter-perfect in the handling of a call under all conditions, and there are many, many conditions which surround a call which the operator must learn—she is sent to a central office. At the central office she is still not permitted to complete calls from the public, but listens in with an experienced operator and one who has been selected for this purpose, due to her particular fitness for assisting the newer girls. After she has been in the central office a sufficient number of days to permit her to become accustomed to her surroundings, she is permitted to answer calls from subscribers, but still under the care of a senior operator who is listening in with her. Her progress is rapid from this time on, and in a comparatively short time she is permitted to answer calls alone. The newer operators, however, are kept at the less busy positions, as it can be understood that the rapidity with which they can handle connections safely and accurately is controlled by their experience. At the end of eighteen months, the operator may be considered as experienced.

It will be seen, therefore, that the telephone companies, in order to render the most efficient service possible to the subscriber, have kept continually at the developing of the switchboard in order to reduce the time period required to establish connection, and in step with this, have trained their operators in a manner so that the public does not have to bear the burden of inexperience, but this latter is removed, as far as is possible, at the training schools.

In the City of Portland, we have 650 operators. It must be remembered that each one of these 650 operators are young women who have been selected for their work. As I have said before, only one applicant in six is accepted for the work, so that here we have a force which has been selected from over 4000 applicants.

It must be seen therefore that in the telephone work we have the highest type of young woman that is in the business world today. Her clients, however, demand exacting attention. They will not stand in line as they do in the theater, or the store, or the barber shop, and await their turn, but demand instant attention. They are in a hurry—that is the reason they are using the telephone—and every second seems a minute long, and any apparent neglect or wrong number is taken as a personal affront by the subscriber. As a matter of fact, the telephone girl in America today has become so efficient that we expect her to be a paragon of perfection. Such complaints as she may get she bears patiently, as she knows very frequently that the wrong number complained of really was called by a subscriber who made a mistake and learned it when the called subscriber answered, but would not acknowledge it and let the called subscriber assume the operator was at fault.

A great deal of her trouble is due to the improper method of talking into telephone transmitters. In the old days, when they had a receiver which they used as both a receiver and transmitter, it is said the companies found it necessary to furnish the subscribers with a notice reading: "Do not try to talk with your ear or listen with your mouth." Today many of the subscribers properly listen with their ears, but they do not talk with the mouths anywhere near the transmitter. The result is that the operator frequently has to ask a second time for the number. If you want to be considered a friend of the central office operator, do what you can to have the public talk into the telephone, and not at it.

We who associate with the central office operator, admire and respect her. We know of her courage and you have frequently read, no doubt, in the public press, of some telephone operator who has stuck by her post in the face of an advancing flood, or other calamity, warning her subscribers of the danger. I have been in a central office in a large city where the operating rooms were covered by an immense glass skylight. When the building adjoining took fire, the flames went across the glass skylight, cracking the glass and filling the room with smoke, but the operators stuck to their post, of attempting to handle the tremendous number of calls occasioned by the fire which was quite a spectacular one. I have been in a tall building in an operating room when the city was shaken by an earthquake. My inclination was to run run for the door. The operators, however, remained at the board, a little pale, perhaps, but ready for the great number of calls which they knew would follow the shake.

During last February's sleet storm, when transportation was at a standstill in the City of Portland, some of our operators waded through snow several miles to get to the central office to help in handling the heavy traffic they knew would have to be handled at such a time. They knew that they would not be criticised for failing to report to the office at such a

time, but they wanted to do their part in giving the public service.

Can you wonder that I, who know what these young women are doing every day, appreciate the opportunity of telling you the part that the telephone operator plays in the telephone world? And this reminds me of another phase of telephone operating which is not in the central office, and over which the telephone company has no control, and that is the operating of private branch exchanges:

The private branch exchange operator in many business houses, and probably in most, guards the entrance through which the greater volume of the business of the firm is done. Notwithstanding the importance of the position, however, I have known girls who were rejected by the telephone company as not fitted for telephone work, being placed in a private exchange position simply on the statement that she had at some time been engaged in telephone work, or had at some time been engaged in private branch exchange work. The young lady, in applying for the work, is not intentionally misrepresenting, but, as a matter of fact, does not know the requirements of the position. This is a matter strictly up to the employer, and he should use the same care in selecting a person for this position that he would for any other responsible position in his business.

During the late night or early morning hours, when a big fire visits a city, you will find telephone operators hastening to the nearest central office to help out the night operators. They do this of their own initiative, as we could not and would not ask them to do it, but it does indicate the general desire of the operators to do their level best to serve the public.

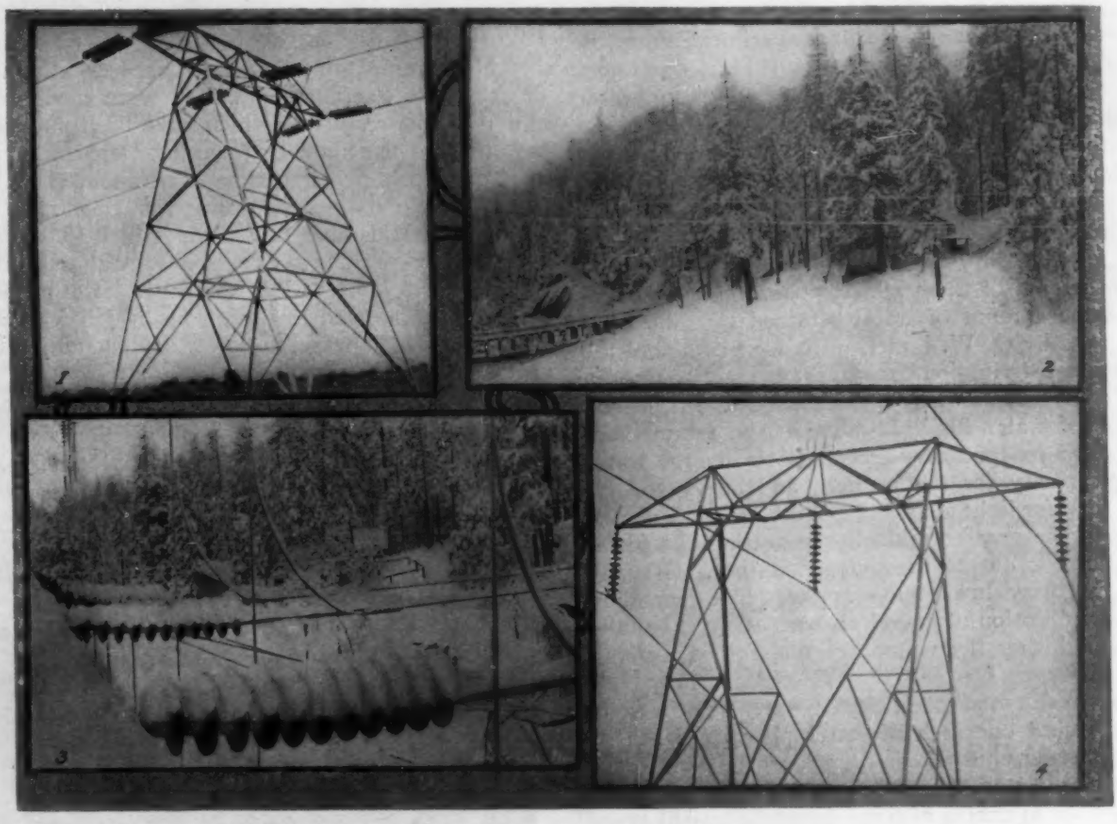
I want you to think over this: Is the private branch exchange operator at your place of business trained for her work? Have you given as much attention to training her to handle your work as the telephone company has given to the training of its central office operators to handle your work?

SNOW SCENES IN TRANSMISSION SYSTEMS OF THE HIGH SIERRAS.

The Pacific Light & Power Corporation has the distinction of possessing one of the highest voltage transmission systems in existence represented by its Big Creek intallation which generates its energy in the high Sierras and transmits it at a voltage of one hundred and seventy-five thousand to Los Angeles, a distance of two hundred and seventy-five miles.

The Bulletin published by that corporation has a most interesting description of snow scenes in the high Sierras in its recent number. Below may be found some views which tell to the eye most emphatically the story of the burden added to a transmission system that develops its energy in the snow-clad Sierras.

The Pacific Light & Power Corporation is to be merged with the Southern California Edison Company as soon as official permission from the California Railroad Commission may be obtained, thus forming the fourth largest central station organization in the United States.



Big Creek Transmission Line.

1. Anchor Tower. 2. Winter Scene—Cascada. 3. Snow on Strain Insulator. 4. Standard Tower.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING.

(A working knowledge of the laws of underground supply for water used in irrigation pumping is proving indispensable as the installation of electric pumps becomes more intense in the agricultural districts of the West. Here is recently compiled material which sets forth a new source of underground supply due to seepage from adjacent projects. A number of power companies and engineers of the West are co-operating with the author in the gathering of this important data.—The Editor.)

IRRIGATION SEEPAGE AS A SOURCE OF PUMPING SUPPLY.

The Borel Canal Concrete Lining Lessens Seepage.

THERE were experiments made near Riverside, California, in 1908, which are given in bulletin No. 203 of the official experiment station of the U. S. Department of Agriculture. On a sandy loam soil it was found that 23 per cent of a 6½ in. irrigation was not accounted for in the upper 6 ft. of soil. This water was applied in furrows and the evaporation loss for the time between samples would be relatively small.

Water becomes distributed more quickly in sandy soils than in those of closer texture. The total moisture holding capacity of light soils is also less. On the sandy soils of the Umatilla Experiment Farm, in Oregon, as given in their report for 1914, it was found that the upper 4 ft. of soil retained no more water from a 5 or a 10 in. irrigation than from one of 2.5 in. depth. In experiments on the Minidoka project in Idaho, given in the Reclamation Record for April, 1916, it was found that sandy and sandy loam soils were only able to retain from an irrigation the equivalent of 4 in. depth of water in the upper 5 ft. of soil.

The results of these and various other investigations of the amount of water retained by soils were summarized by O. W. Israelson in a paper before the International Irrigation Congress at Sacramento in 1915. These gave an average retention in 6 ft. of soil of 5.3 in. of water for light soils, 4.0 in. for medium soils and 3.5 in. for heavy soils. Normally the water holding capacity for the medium and heavy soils is greater than for light soils, the smaller amounts shown are due to the greater difficulty in getting the water into these soils due to their closer texture. Gravelly soils would have lower moisture capacity depending upon the proportion of gravel present. Gravel has the effect of reducing the volume of fine soil in a given depth.

These results indicate that the water held by soils will not exceed one inch of water per foot depth of soil except under unusual conditions. If the plant roots can use the moisture in the soil to a depth of six feet, any irrigation in excess of 6 in. would be lost by deep percolation. If the soil is irrigated before becoming relatively dry, the amount which can be retained would be reduced.

In heavy soils, the movement of moisture, through the soil is slower and a less depth per irrigation is usually applied. For this reason the amount of deep percolation loss is less.

The amount of water used per irrigation varies widely. On light soils it may be difficult to cover the fields without using more water than is required by the soil. With flooding methods of application this is particularly true. The average depth used per irrigation in extensive measurements made in Idaho from 1910-1913 was 6 in. on grain and 7 in. on alfalfa. Most of the soils were of relatively high water holding capacity. Individual irrigations varied quite widely and it is probable that the average deep percolation loss was at least 1 or 2 in. depth of water per irrigation. That such losses are occurring there is instanced by the rise of ground water which has taken place in the vicinity of Twin Falls since irrigation has been introduced. Investigations have shown the rise of ground water to have been as high as 25 ft. in some years, in 1914 it was 9 ft.

Measurements of the water used on alfalfa in 81 fields in the Sacramento Valley were made in 1913 and 1914, the results of which have been published in bulletin 1 of the State Engineering Department. The average depth per irrigation was about 8 in. The largest average for any locality was 1.35 ft. or 16 in. depth for 9 fields near Los Molinos in 1913, the smallest 3 in. for very heavy soils near Willows in 1914. These figures indicate that there is a large proportion of the water applied to these soils which was not retained but which passed to lower depths and joined the ground water.

If land is to be flooded without using excess depths per irrigation the method of applying the water must be such that the land can be covered quickly. Six inches depth of water will usually be absorbed by

Typical Canal Design for Citrus Fruits.

sandy soils in less than one hour. With very light soils it may be difficult to flood over the surface without having more than six inches depth absorbed. For the heavier soils the time will increase, for loams water should not usually be applied to a check for over two hours. With heavy soils the time is limited more by the length of time the crop can stand irrigation without scalding than by the rate of absorption.

The same soil moisture properties apply to water used under pumping plants as to that secured from gravity supplies. Owing to its generally greater cost, the average practice with water which has been pumped is of a higher type with less carelessness in handling. If too large a depth is applied in a single irrigation from a small pumping plant the excess will percolate downward to rejoin the water table from which it was pumped unless impervious strata occur in the soil.

When the conditions of general practice are reviewed in the light of the data given on the moisture holding capacity of soils the conclusion seems warranted that probably an average of at least 20 to 30 per cent of the water applied to crops by flooding methods percolate beyond the reach of plant roots. Where furrows are used the amount applied is generally less but there may be considerable loss from deep percolation under the furrows. For porous soils carelessly irrigated the deep percolation loss may exceed one-half the amount used.

In general the surface and underground waters of any stream basin are relatively distinct from other basins. This may not be the case in the San Joaquin and Sacramento basins where the underground waters may be continuous and not directly dependent entirely on local tributaries.

Any deep percolation or canal seepage loss in one portion of a stream system generally contributes to the supply lower down on the same stream. This may occur only as a rise in the ground water. It more usually occurs as a return flow to the lower stream channel. There are a number of Western streams from which, at different points, the entire flow may at times be diverted and the return flow be sufficient in amount to supply the lower canals. It has been estimated that the return flow from some of the streams in northeastern Colorado equals one-third of the amount of the diversions. As the return flow from the diversions in the earlier season may reach the stream so as to increase the later season low flow, this is of very material assistance in supplying canals.

That the percolation losses in irrigation are large is also shown by the rate of discharge which may be secured from drainage systems in irrigated lands. The records of some drainage systems show the water removed to equal from 20 to 30 per cent of the amount applied to the land. As further amounts will be removed by the natural ground water drainage, the general figures given for average losses of 10 to 15 per cent in canal laterals and 20 to 30 per cent in deep percolation from fields do not seem unreasonable. For poorly maintained canals or for careless use of water on porous soil the amounts of such losses may exceed and even double the figures given.

FLOW OF WATER IN WOOD STAVE PIPES.

Bulletin 376 of the U. S. Department of Agriculture on "The Flow of Water in Wood Stave Pipe" adds much to our present knowledge of this important subject.

For formulas for the flow of water in wood-stave pipe, the exponential form is recommended. The formulas deducted by Mr. Scobey are:

$$H = \frac{7.68\ V^{1.9}}{d^{1.17}} = \frac{0.419\ V^{1.9}}{D^{1.17}}$$

$$V = 1.62\ D^{0.75}\ H^{0.550}$$

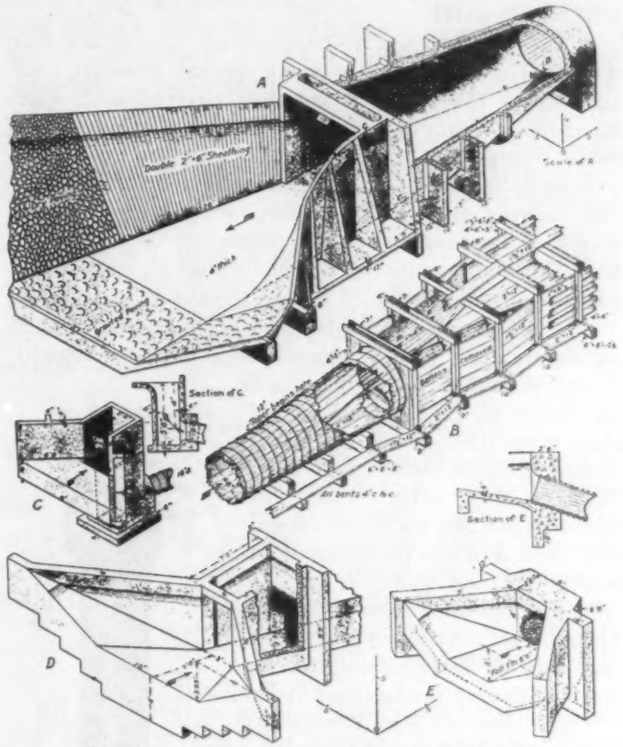
$$A = 1.272\ D^{2.05}\ H^{0.535}$$

in which

H = friction loss in feet per 1000 ft. of pipe.
V = mean velocity of water in feet per second.
d = mean inside diameter in inches.
D = mean inside diameter in feet.
A = mean discharge in second-feet.

Factors of safety of from 5 to 15 per cent are recommended where the conditions of use such as silted water, growths of vegetable life are unfavorable, or where penalties for deficient capacity are attached.

In his discussion Mr. Moritz deduces a formula



Governmental Suggestions for Inlet and Outlet. Structures for Inverted Siphons.

$$\text{of the form } H = \frac{0.43\ V^{1.9}}{D^{1.25}}$$

from the results of these experiments. This gives results 7.6 per cent smaller than the formula previously suggested by Mr. Moritz and now used by many engineers. This difference is due to the fact that Mr. Scobey tested a number of the larger sized pipes which gave lower capacities than the test of the large pipe for which results were available when the early Moritz formula was derived.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A. SCHNEIDER.

(Resistance units to replace carbon lamps, new methods of specifying pulley dimensions, too much battery and a "safety first" flush receptacle are some of the new problems that are solved for the contractor and dealer in this issue. Other articles on perplexing problems of wiring installations, motor control and operation, window display, cost keeping and a thousand hourly obstacles to business efficiency in the life of the contractor and dealer are soon to follow. The author is apparatus specialist for the Western Electric Company.—The Editor.)

SIZE OF RESISTANCE UNITS TO REPLACE CARBON LAMPS.

Now that carbon lamps are not so generally used and because the characteristics of Mazda lamps do not make them desirable for resistance purposes, resistance units are being widely adopted to replace carbon lamps. The difference between the Mazda lamp and the carbon lamp is that in the former the resistance increases very rapidly with the current, whereas the resistance of the carbon lamp is fairly constant over a wide range of current. Resistance units are, however, so designed that the resistance remains practically constant at any current the units will safely carry.

These resistance units are made up by winding wire of German silver or some similar material upon supporting tubes, which are then covered with a cement-like coating or with a fused vitrous enamel. The tubes consist of asbestos paper, lava, pottery, enameled iron or other miscellaneous material, depending upon the type of unit and its purpose. Many different forms of terminals or attachments can be furnished to make them suitable for mounting in special apparatus or for making up special groups of resistances.

When adopted to replace lamps, the unit equipped with a standard Edison screw base is most convenient. A unit mounted in this manner is shown in the illustration, which also gives the principal dimensions. This particular unit has a capacity of 60 watts for continuous duty or 210 watts for 20-second duty, and can be furnished in any resistance from 2 to 1000 ohms. Many other sizes can be furnished, each of the several manufacturers of resistance units having many different ratings and types.

To replace an 8 candle-power, 110 volt carbon lamp, the manufacturer of the particular unit shown recommends a unit wound for approximately 440 ohms, with a maximum carrying capacity of .37 amperes, or a unit of 220 ohms, and .52 maximum amperes, to replace a 16 candle-power lamp of the same voltage. Two of these 220 ohm units connected in parallel will be equivalent to a 32 candle-power, 110 volt lamp. While the cost of such units is considerably more than carbon lamps, they have the advantage of not being easily broken and will last indefinitely if not worked beyond their safe carrying capacity.

It is well to note that while the term "resistance unit" is used in this article, the more correct expression is now "resistor unit," in accordance with the latest standardization rules of the American Institute of Electrical Engineers. Article 81, under caption "Definitions," in these rules reads: "Resistor. A device, heretofore commonly known as a resistance, used for the operation, protection or control of a circuit or circuits." This recommendation is being adopted by the various manufacturers as their descriptive literature and price sheets are revised, and will shortly be in general use.

TOO MUCH BATTERY.

The four requisites of a reliable annunciator signal system are a good annunciator, a suitable system of conductors thoroughly insulated to prevent grounds, crosses or short circuits, a battery of the proper type and number of cells, and the necessary signal stations, usually consisting of push buttons. When properly installed such apparatus is not likely to get out of order, but it is occasionally necessary to renew the battery. Ordinarily, however, the batteries receive no attention whatever until the system fails to work so it is quite logical to blame run down batteries for almost every case of annunciator trouble.

A case of annunciator trouble quite different from those commonly reported caused by too many batteries was once noted by the writer.

A one hundred drop annunciator had been installed in a hotel. After having been in use for a few months it began to give trouble, only indicating part of the time. The repairman immediately inspected the battery and decided to add three more cells to the original set of three making six No. 2 Samson batteries in series, which should be sufficient for a very large system. After working for a few weeks the same trouble again developed.

But this time another repairman came upon the job. He also decided that more battery was required and added two more cells. The system kept going from bad to worse and finally for some unknown reason the battery was increased to a total of sixteen cells connected eight cells in series and two banks in parallel. This, however, did not remedy the trouble.

About that time the local inspector of the lighting company happened to see the repairman working on the trouble and listened to his story of the mystery. The inspector suggested that the large number of

cells had probably burned the contacts in the bell. This was found to be the case. A new bell was fastened on the back of the annunciator without disturbing the original one and the leads transferred to it. Then all but three cells of battery were removed. The system then worked perfectly, much to the surprise of the several repairmen who had failed to locate the real cause of the trouble.

This same thing is likely to happen when using bell ringing transformers if the voltage of the secondary is too high. In either case the lowest possible voltage should be used. Some of the modern transformers have several taps giving more than one voltage, so the best voltage for the particular circuit can be selected. This permits the bells nearest the transformer to work at one voltage and those farthest away at another, if necessary.

NEW METHOD OF SPECIFYING PULLEY DIMENSIONS.

In the past it has been customary when ordering pulleys for motors and generators to specify the diameter and face of pulley required in addition to the usual information covering shaft dimensions. This method appears to have been somewhat unsatisfactory, as one of the large manufacturers of paper pulleys now recommends that the belt width be adopted in preference to the pulley face. The full width of pulley is then made to exceed the belt width by approximately the following amounts:

Belt width within the following limits.	To obtain full width of pulley belt width is increased by
Up to 2 in.	¼ in.
2 to 5 in., inclusive.	½ in.
5 to 12 in., inclusive.	¾ in.
12 to 24 in., inclusive.	1 in.
24 to 36 in., inclusive.	1½ in.
36 in. and larger.	2 in.

For example, a pulley 4½ inches in diameter with a face width of 4½ inches would have an effective face of 4 inches and be suitable for a four-inch or smaller belt.

This method has been adopted by a number of motor manufacturers, and is recommended to others who are interested in such apparatus.

It is well to note that double belts should not be used on pulleys smaller than 9 inches in diameter, and that the belt speed in any case should not exceed 5000 ft. per minute, because high belt speeds reduce the arc of contact on the pulley by centrifugal action.

The maximum pulley diameters which can be used with motors and generators at various speeds with belt speed limited to 5000 ft. per minute are as follows:

Speed r.p.m.	Max. Safe Pulley Diam. in in.	Speed r.p.m.	Max. Safe Pulley Diam. in in.
1800	11	750	25
1500	13	720	26
1200	16	600	31
1000	19	514	37
900	21	450	42
800	23		

A "SAFETY FIRST" FLUSH RECEPTACLE.

The principal objection to the ordinary screw base receptacle has always been the possibility of shock by accidental contact or the short-circuiting of contacts, and excessive arcing with the danger of short circuits on removing the plug with the circuit closed. These very shortcomings of this form of receptacle undoubtedly explain, at least in many cases, why baseboard receptacles are not more commonly used in residences, for it is a fact that some people are rather dubious about such devices, especially where there are children in the family. And there is really some grounds for this feeling, for every once in a while one hears an incident relating how a child was badly frightened or perhaps slightly burned its fingers by inserting some metal object, quite often a pair of scissors, into one of these receptacles. Even though there is not an actual physical injury, the experience is rarely forgotten and often related to neighbors and friends. Then again there is generally the expense and aggravation due to blown fuses which may cut off the entire service.

Still this form of receptacle is very useful and very common, because it is the only type now on the market which will accommodate all makes and styles of attachment plugs which are ordinarily furnished with miscellaneous appliances.

To overcome the objections herein noted there is now being placed upon the market a line of screw base flush receptacles in which both contacts are normally dead and become alive only upon screwing the plug full way into the receptacle. The center contact has to be pressed solidly inward and the outer or shell contact becomes alive only when drawn outward, both motions being completed when the plug is screwed into place. Upon removing the plug with the current on, the circuit is broken at three points in series, thus greatly reducing the possibility of serious arcing.

This is a truly "Safety First" device and should prove an unusual leader for the electrical contractor, for it eliminates a strong objection often raised against baseboard receptacles. More receptacles mean more appliances, the effect is cumulative.

EMERGENCY REPAIR PARTS.

In these days of slow delivery and depleted stocks every dealer handling motor installations can do those of his customers having such apparatus a good turn by calling to their attention the advisability of carrying a few spare parts for an emergency. A few parts kept on hand represent but a small investment but may ultimately mean a saving equal to many times their cost. Still it is surprising to note how often this matter is entirely neglected

The number of parts which should be carried will depend largely upon the number of motors in use, their type and size and upon whether the motors are to operate under severe conditions where there is more likelihood for breakdowns. For direct-current and single-phase motors it is good practice to carry a set of bearing linings and brushes. For squirrel-cage induction motors a set of bearing linings will usually be all that is necessary except when the motors are equipped with starting compensators in which a set of contact fingers and segments with necessary screws should also be carried for each size. If the motors are of the slip-ring type a set of brushes for the collector rings, a set of fingers or segments for the controller and a set of bearing linings should be provided.

ELECTRIC COOKING AND HEATING

(The electric furnace is finding an ever increasing field of application in the industries of the West. Its economc features and delicate control are so superior to any other known source that it bids well to replace other methods of heat application. In this article the author sets forth the fundamental factors that enter into electric furnace design and illustrations of typical installations are given.—The Editor.)

ELECTRIC FURNACES.

BY E. A. WILCOX.

Economic Advantages.—The use of electric energy for producing furnace heat has revolutionized many modern industries. The field which it has created in the development of electrochemical and metallurgical processes has great possibilities. Not only does the electric furnace afford opportunity for improving and widening these industries, but its use

Pouring From Snyder Steel Furnace.

requires large quantities of electric power, the development of which produces a market for energy that might otherwise lie dormant or go to waste. Furthermore it improves the load factor and diversity of large central station loads, and otherwise tends to foster greater economic wealth.

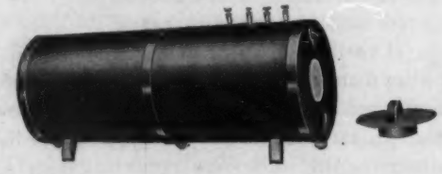
Only high temperature furnaces for melting and refining various substances will be considered in this chapter. The general design, manner of operation, and field of application of electric furnaces will be outlined so as to convey an understanding of the subject.

The Electric Furnace Field.—The application of the electric furnace has made it possible to manufacture a number of substances that would otherwise not be available for commercial purposes if combustion methods were the sole means of production. None other than electric furnace methods have ever been successfully employed in the manufacture of such well known substances as carborundum, aluminum, and calcium carbide. Immense industries have been built up, and great quantities of power employed for their production. There are many other processes that may be performed only with the electric furnace, but the extensive applications of which are limited by the cost of production. There is little doubt but that more of the supply of nitrogen required for soil fertilization will be drawn from the air by electric furnace apparatus, as the present rapidly depleting natural nitrate deposits become exhausted. Several plants located where electric energy is cheaply produced, now manufacture great quantities of nitric acid and nitrates and consume enormous amounts of power.

The electric furnace may create temperatures greatly in excess of those otherwise available. With present apparatus operating temperatures as high as 6500° F. may be attained. The exclusion of objectionable furnace gases and air, makes it possible to perform many new operations. The smelting of various metallic ores that formerly could not be handled satisfactorily or economically has been made possible.

Probably the greatest field for utilizing the electric furnace, at the present time, is in its application to such processes as are now largely performed with fuel burning furnaces. It is in this field, however, that the electric method has to compete on the basis of both cost and quality of product.

Character of Furnace Power Loads.—Some concerns using electric furnaces do not attempt twenty-four hour operation on account of the usual inefficiency of night work. This is especially true of those engaged in steel manufacturing. Some furnaces have to be shut down while the products are removed and new charges introduced. The resulting load factor is relatively high, however, as compared with average central station motor service.



G. E. Laboratory Tube Furnace. (Max. temp. 1832° F., 2½ in. diameter, various lengths.)

Some smaller furnace installations may be shut down from three to four hours per day without serious disadvantage and this condition often makes it possible to utilize off-peak power. Where steel melting furnaces are used, it has been found advisable in many instances to mould during the day and melt at night. This practice has developed an all-night furnace load for the power company.

The variations in current in an electric furnace are usually due to changes in condition of the charge. Some furnaces are operated in series with a ballast. For direct current service the ballast has to be a resistance, whereas for alternating current service a resistance or a reactance may be used. The power

factor of induction furnaces is generally low. It may be raised by lowering the frequency, or by using a synchronous motor as a condenser.

Character of Service Required.—Alternating current is used in furnace work more often than direct current. For induction furnace operation alternating current is employed, whereas direct current is required in electrolytic furnaces. In most arc and resistance furnaces either alternating or direct current may be employed.

The voltage required for furnace work is generally low (50 to 200) although in nitrogen furnaces pressures as high as 5,000 to 10,000 volts are often utilized. The size of furnace loads usually makes it necessary to reduce the voltage at the point of delivery, and consequently almost any available primary

G. E. Crucible Furnace. (Max. temp., 1112° F., crucible 1 in. by 2 in. high.)

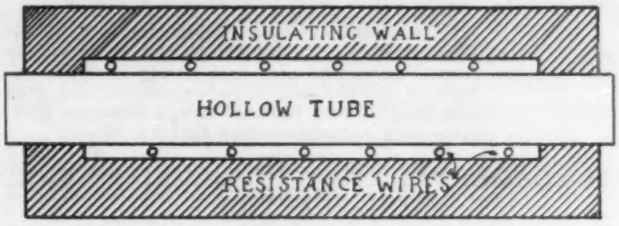
voltage may be used. The higher the voltage applied the less is the current required, the smaller the electrode cross section, and the less the heat conducted out of the furnace through the electrode. Voltages are limited, however, from considerations of the safety of operators.

Arc and resistance furnaces are usually built for 60 cycle operation in sizes under 1000 kilowatts. Larger furnaces are generally constructed for lower frequencies. Induction type furnaces usually require special low frequencies in sizes larger than 500 kilowatts capacity.

Most furnaces are operated with single-phase service. The larger resistance furnaces for manufacturing chemical products, graphite, and carbide use single-phase service. Nitrogen fixation furnaces are generally connected so as to use three-phase current. Two and three-phase energy is frequently utilized in steel making although it is contended by some manufacturers that single-phase service is more efficient and satisfactory from the standpoint of furnace operation. A single electrode furnace is somewhat cheaper and more readily manipulated; the heat losses are less; and the electrode and refractory roof costs are smaller. On the other hand, most power producers prefer to deliver two or three-phase energy for obvious reasons. Central station companies having 4-wire, three-phase distribution systems are sometimes able to supply single-phase service by suitable arrangement of tranformer connections.

Classification of Electric Furnaces.—Electric furnaces may be divided into two general classes, the resistance type, and the arc type. It is often difficult to distinguish the class to which different furnaces belong, because both the heat of the arc, and the heat resulting from the resistance to the flow of current, are frequently utilized in heating the charge.

Resistance type furnaces may derive heat from the passage of current through resistance wires, through other resistance materials surrounding the charge, or by the passage of current through the



Tube Furnace.

charge itself. Examples of furnaces employing resistance wires as a means for heating the charge are found in the ordinary small crucible, tube, and muffle type furnaces often used in laboratories for operation at temperatures under 1800° F. Typical examples of the second type of resistance furnaces are those of the Acheson carborundum furnace and some of the well known high temperature electric crucible furnaces. The induction type furnace, wherein a current is induced in the charge by electromagnetic induction, is one of the best examples of the third type of resistance furnace. A sharp distinction between these three classes is often impossible because some types involve more than one principle in their design.

Furnace With Resistance in the Charge.

Arc furnaces may be divided into three classes, the principles of which may or may not be combined in one type of apparatus. The first class, known as the direct arc furnace, produces heat by causing an arc between the electrode and the charge. The second class known as the series arc furnace passes current from one electrode to the charge and from the charge back to another electrode. The third class, known as the indirect arc furnace, produces heat between electrodes supported above the charge.

A more complete classification of electric furnaces is given by Stansfield in his excellent text on "The Electric Furnace" as follows:

Classification of Electric Furnaces.

(1) Resistance Furnaces.
  (a) Using special resistance.
    (1) Resistance wires in furnace walls (tube furnace.)
    (2) Resistance material in the charge (carborundum furnace.)
  (b) No special resistance.
    (1) Electrolytic (aluminum furnace.)
    (2) Using charge as resistance.
      (a) Solid material (graphite furnace.)
      (b) Melting material (Heroult smelting furnace.)
      (c) Liquid material (induction furnace.)

(2) Arc furnaces.
  (a) Direct arc.
    (1) Single arc (Girod furnace.)
    (2) Series arc (Heroult furnace.)
  (b) Indirect orc (Stassano furnace.)

FUEL OIL AND STEAM ENGINEERING

(Fuel oil and steam engineering to be properly understood must be considered from the fundamental laws of energy. In this article the author begins with the laws of motion originally propounded by Sir Isaac Newton and ends with setting forth the principle of conservation of energy wherein it is shown that fuel oil practice and steam engineering are principally concerned with transforming the latent chemical energy of oil into potential energy of steam, later to be transformed into energy of motion in the power generating apparatus.—The Editor.)

FUNDAMENTAL LAWS INVOLVED IN FUEL OIL PRACTICE.

BY ROBERT SIBLEY.

Mechanical Energy in Reciprocating Units at Redondo.

IN the awful throes of the French Revolution and the immediate years following, the old saying that "every cloud has its silver lining" proved true in certain lines of scientific advancement, for the metric system of units was conceived and put into practice at that period.

Our modern system of Arabic numerals, now practically universally adopted throughout the civilized world, required over five hundred years of human fumbling and competition with the old Roman method of numerical representation, before a complete replacement was accomplished, so intensely are we all creatures of habit and slaves to tradition.

And so it is that although a period of a century is now passed since the institution of the metric system, modern central station engineering practice is still entangled with Fahrenheit scales, boiler horsepowers, mechanical horsepowers, myriawatts, Beaume scale readings for gravity, inches of mercury vacuum, pounds pressure per sq. in., feet and inches—all units related so unscientifically and empirically as to cause bewilderment in itself.

In the following discussion, however, the author shall endeavor to set forth the various units of expression in such simple language that it is hoped that even the beginner may have little difficulty in understanding their meaning. Let us first get some conception of the need for units of measurement and how such units are fundamentally conceived.

Newton's Laws of Motion.—Fable has it that Sir Isaac Newton, when a boy in England, lying one day under an apple tree and gazing upward, saw an apple fall to the ground. The contemplation of this phenomenon lead Newton to give to the world three fundamental laws upon which modern engineering science is built. Briefly stated these laws are as follows:

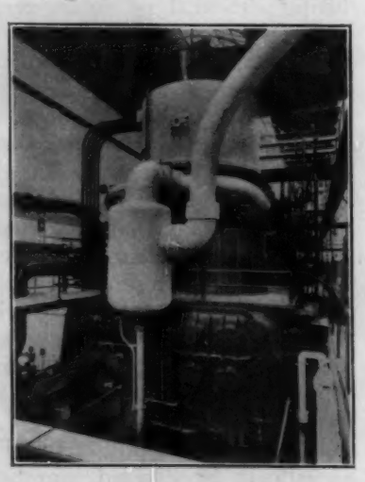
Law 1. Everybody continues in a state of rest or a state of uniform motion in a straight line except in so far as it may be compelled by force to change that state.

Law 2. Change of motion is proportional to impressed force and takes place in the direction of the straight line in which the force acts.

Law 3. To every action there is always an equal and contrary reaction; or the mutual actions of any two bodies are always equal and oppositely directed.

Hence a force is said to be acting according to Law 1 whenever the physical conditions are such that velocity is changed in magnitude or direction. Thus, when a train of cars is started or stopped, a force is necessary to cause this phenomenon, and this is evidently a change in the magnitude of the velocity. On the other hand, in the rotation of a fly wheel, the velocity may change solely in direction without a change in magnitude, and yet a force be necessary to maintain its parts in equilibrium. Hence a force may be considered as a push or a pull acting upon a definite portion of a body, but this tendency may be counteracted in whole or in part by the action of other forces. In the latter instance the force is usually denoted as pressure, and it is the consideration of this latter case, or the consideration of pressures, that will largely concern our attention in the generation of steam in a boiler.

Three Fundamental Units of Length, Mass and Time.—In considering Law 2, it is seen that there is some inherent property in matter that makes it difficult to set it in motion. Physicists have defined this quality of matter as being the inertia of a body. Inertia is expressed quantitatively in engineering practice in terms of its mass, which is measured in pounds. In order that these quantities, force and mass, now introduced may be quantitatively measured, it is necessary to have some fundamental units upon which to base our computations. Three units only are fundamentally required; namely, a unit of length, a unit of mass, and a unit of time. Scientific practice has deduced for these units the centimeter, the gram, and the second, which are well known and need no further illustration. In engineering practice, however, especially among English-speaking people, the foot, the pound, and the second seem to be in almost universal usage. We shall consequently largely express our deductions in terms of these latter units.



Electrical Energy from Steam Turbine in San Francisco.

Velocity, Acceleration, and Force Defined.—Having now decided upon the three fundamental units of

measurement, let us look into other fundamental definitions and secondary units to be employed.

Since engineering science must deal with motion and the change of motion per unit of time, it is necessary that we have units wherein to measure them. Change of motion per unit of time is known as velocity and is expressed in feet per second. A change in motion may, however, be undergoing a change, and this phenomenon is known as acceleration, which is measured by the change of velocity in feet per second.

Since a force, **P** is fundamentally defined as being proportional to the change in motion of a body, it follows that a force is equal to a constant, **M**, multiplied by the change in motion, or, in other words, multiplied by the acceleration, **a**.

When **M** is in pounds mass and **a** is acceleration in ft. per sec. per sec.., the force **P** is measured in **poundals**. The **pound force** is the unit, however, that has been universally adopted in engineering practice. The pound is such a force as will give to a pound mass the same change of motion per second as is acquired by a body falling freely to the earth's surface. A body falls to the earth's surface with an acceleration of g ft. per sec. per sec., wherein g has an average value of about 32.16. We have then the fundamental mathematical expression for force n pounds as follows:

$$P = Ma \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Whenever, however, it is necessary to ascertain the mass **M** in pounds from the known weight **W** of the body in lb., it is necessary of course to divide **W** by **g** in order to ascertain the mass. Thus we have in this case

$$P = \frac{W}{g} a \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1a)$$

Thus, if an automobile weighing 3000 lb. accelerates from a stand-still to forty miles per hour in fifteen seconds, we compute the force required to accomplish this as follows:

$$P = \frac{3000}{32.16} \times \frac{40 \times 5280}{60 \times 60 \times 15} = 367 \text{ lb.}$$

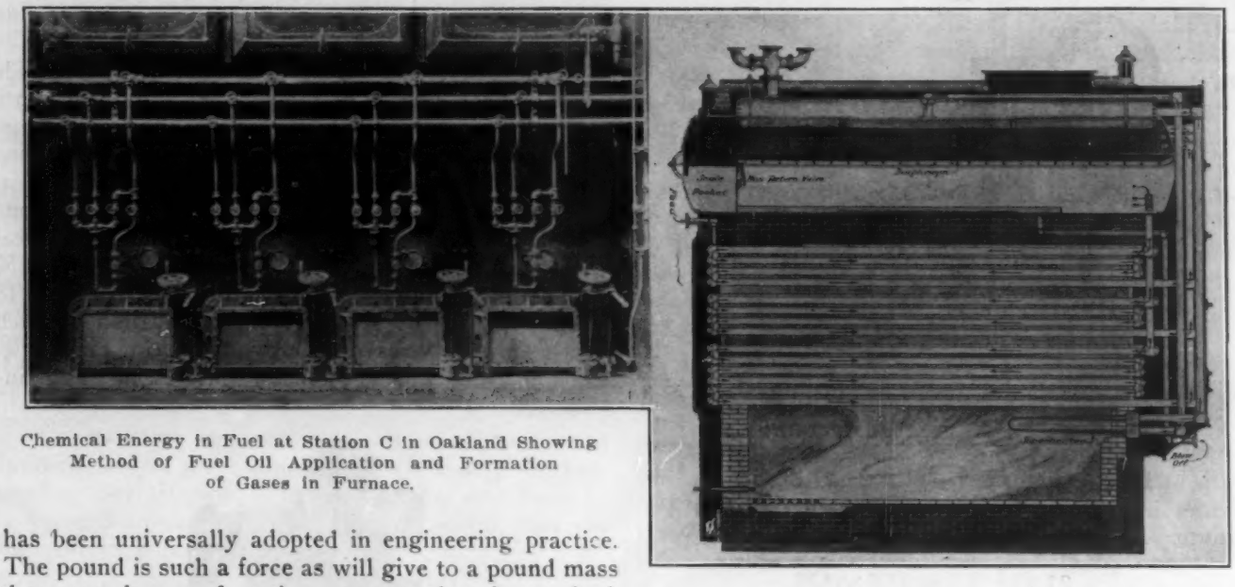
Since this total force must be supplied from the engine cylinder this now gives us a preliminary clew as to how the total engine cylinder area is to be proportioned.

Bodies acquire different changes of motion per second, or, in other words, different accelerations at different points on the earth's surface. A formula has been established by means of which proper corrections may be made. A concrete illustration of this will appear in the next chapter wherein a mercury column is used to measure atmospheric and vacuum pressures at different latitudes and altitudes.

It is unfortunate that mass and force have the same unit of expression, for they are definite distinct physical concepts and should be carefully distinguished in order to avoid confusion.

Conception of Work and Power.—In Law 2 we are informed that the change of motion takes place in the direction of the straight line in which the force acts. It is often convenient to note quantitatively the product of the force and the distance through which the force acts. This product is called "work" and is numerically computed by multiplying the force in pounds by the distance in feet through which the force acts. The resulting computations are then expressed in foot-pounds (ft. lb.). Thus, if the mean effective pressure, **P**, in a cylinder is measured in pounds per sq. in. and the piston has an area of **A** sq. in., it follows that the total force or pressure acting in the direction of the motion of the piston is **PA**. When this force has pushed the piston the length of its stroke, **L** ft., the work accomplished is **PLA** ft. lb., since this is the product of the force and the distance through which the force acts. If there are **N** working strokes per minute, the ft. lb. of work accomplished every minute are now seen to be **PLAN**.

The mention of the words "per minute" in the last statement now indicates to us that the time taken to perform a given quantity of work in engineering practice is of vast importance. Consequently this fact necessitates still another unit of measurement, namely that of power. Power is defined as the time rate



Chemical Energy in Fuel at Station C in Oakland Showing Method of Fuel Oil Application and Formation of Gases in Furnace.

of doing work. The horsepower is the basic unit. When 550 ft. lb. of work are performed per sec., or 33,000 ft. lb. per minute, a horsepower is said to be developed. Hence, since in the above engine cylinder **PLAN** ft. lb. per min. are being developed, the horsepower is computed as follows:

$$\text{H.P.} = \frac{\text{PLAN}}{33{,}000} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Thus, in Alameda, California, a certain Diesel oil engine has a piston area of 37.7 sq. in., a stroke of 1.5

The Steam Gauge Tester Illustrates the Application of a Fundamental Law, wherein a Pressure is Balanced Against the Force Due to Gravity.

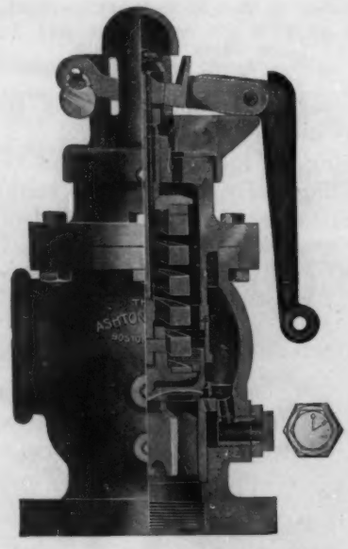
ft., a mean effective pressure of 23.36 lb. per sq. in., and each cylinder makes 125 working strokes per minute. Hence, each cylinder develops

$$\text{H.P.} = \frac{23.36 \times 1.5 \times 37.7 \times 125}{33{,}000} = 50.0$$

In a later discussion the particular power units employed in steam engineering practice will be considered in minute detail, such, for instance, as the horsepower, the boiler horsepower, and the myriawatt.

Various Types of Energy Employed for Useful Work.—Another important consideration is that of the physical characteristic of a body which enables it to perform work. This physical quality possessed by a body which enables it to perform a definite quantity of work is spoken of as its energy. Energy then is the capacity for work. In general we meet with two great classes of energy. One is that of **kinetic energy,** or energy of motion. According to Law 2, if the motion of a body be changed, a force is required. Hence a body actually in motion possesses kinetic energy. The other type of energy is known as **potential,** or energy of position. Thus steam moving with a high velocity, by the nature of its kinetic energy, is enabled to drive the wheels of an impulse turbine. On the other hand, crude petroleum when heated so that it will unite with the oxygen of the air gives out energy in the form of heat, which may be caused to do useful work. The energy inherently latent in the crude petroleum is known then as potential energy. Engineering practice is largely concerned with the harnessing of various forms of energy. Looking about us in nature and in modern engineering accomplishment, we may see numerous instances of energy. The steam engine and steam turbine indicate a form of mechanical energy; the incandescent light, or the dynamo, that of electrical energy; the evolving of heat in the burning of crude oil, that of chemical energy; the human conducting of affairs, that of human energy; the rays of light from the sun, dissipating eternally 10,000 h.p. over each acre of the earth's surface, that of solar energy, and so on indefinitely. Modern investigation has conclusively established the fact that all types of energy are interchangeable, and though some types of energy are more readily convertible into other types, yet the basic law is true that no energy in sum total is ever destroyed, and on this basis, or law, known as conservation of energy, practically all of our engineering formulas and computations are evolved.

The conversion of the chemical energy of crude oil into heat energy of the furnace and thence into steam largely concerns our attention in this discussion. Thus each pound of California crude oil will be found in later articles to contain approximately 18,500 British thermal units of heat energy. This energy of one pound of oil when wholly converted into mechanical energy is sufficient to lift a person weighing 150 pounds through a vertical skyward journey of some 18 miles. Hence the study of the application of such enormous reservoirs of energy, latent in crude petroleum, will prove intensely interesting and instructive.



The Safety Valve Shows the Possibility of Safety Application, when Pressures Become Unbalanced.

Bearing in mind these fundamental laws, we should now be able to see mentally the exact changes of energy that are going on in the modern power plant. First as chemical energy in oil, next as latent heat energy in chimney gases, then as latent heat energy in steam, next as energy of motion in the moving parts of the power generating apparatus, the final transformation as electrical energy is brought about.

SPARKS—Current Facts, Figures and Fancy

A half-million dollar plant in Wyoming designed for the manufacture of gasoline and carbon black from the flow of gas in the oil wells of that commonwealth is now under construction.

* * *

With but one single exception the quicksilver output of California during the past year which was valued at nearly four million dollars is the largest in the history of that state.

* * *

The new year finds the West in better financial position than ever before in her history. Bank deposits and bank clearings never before reached such totals as are now being recorded.

* * *

A well known Eastern authority has recently been quoted as saying that the thing that justifies the advertising of electricity is that everybody has a desire to use it, or at least to be a beneficiary of its service.

* * *

The electrical exports for October last have again set a new record. A total export value of over four million dollars in value representing nearly twelve and one-half per cent increase over the best previous month is recorded.

* * *

Constructive imagination combined with an inward appreciation of the symmetry and beauty of harmonious development is becoming more and more to be recognized as one of the greatest assets that the engineer may possess.

* * *

Manchuria, the rich province of northern China, will harvest nearly two million tons of beans this year. The well-known power possibilities of this section of China will some day be a rich natural asset to aid in its economic agricultural development.

* * *

The steam from a volcano in central Tuscany, Italy, is utilized in power development. It is said that a three thousand kilowatt steam plant is so operated. Perhaps the great volcano in the Hawaiian Islands may some day find similar application.

* * *

As an instance of the growing American commercial and engineering relations the dividend of the Nippon Yusen Kaisha steamship line plying between Japan and Seattle may be cited. A dividend of twenty-eight per cent per annum has just been issued.

* * *

The output of coal in the United States for 1916 was considerably over a half billion tons and broke all previous records. Crude petroleum output also passed all previous records in a total production of 292,300,000, twenty-five per cent of which came from California oil fields.

* * *

Copper has soared in value to such profitable heights that the right to recover metal from river slime by scraping the great deposits along river bottoms in the Coeur d'Alene country of Idaho is being asked of the farmers owning the riparian rights who are to receive a five per cent royalty.

* * *

An electrical man of Oregon has built his home so electrically equipped that no chimney has been included in the design. The Diesel engine has made possible the ocean-going vessel without the customary smoke-stack and now electricity bids well to complete the transformation in the home.

* * *

The steamship Balboa has lowered the record for time of passage through the canal. Entering from the Pacific at 11:35 a. m., Sunday, December 3, she reached Cristobal at 6 p. m., having taken 6 hours and 25 minutes in passage. On the same day the Cauca made the transit in 7 hours and 9 minutes, and the San Juan in 8 hours and 5 minutes.

* * *

Ship building continues unabated on the Pacific Coast. The launching of the seventy-one hundred ton turbine ship Thordis, at Oakland, during the week to be followed shortly by another of similar capacity, together with one of ten thousand ton capacity is typical of weekly progress throughout the other ship building districts of the West.

* * *

Texas and Kansas farmers are making sweeping returns on broom corn. One man realized one hundred and seventy-five dollars per ton for his crop. The house broom is used West of the Rockies and the electrically operated pump is supplying the water to its productive lands. Perhaps this is enough said as a tip to Western power salesmen for new business.

* * *

The U. S. Geological Survey in its recent report to the Secretary of the Interior, commenting on the efficiency of Western mining operations, calls forceful attention to the fact that again copper stands out as the best illustration of how American mines can meet a world demand. The output of nearly 2 billion pounds of the red metal is double that of ten years ago and its value is twice that of the copper produced in 1915. Add to this the fact that in value copper now contends with iron for first place among the metals and that together the amount of these two metals produced last year had a value of more than one billion dollars and we have a measure of what this country can contribute in useful metals.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of five days prior to the dates of publication, which are the first and fifteenth of each month. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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THANKS.

The Journal takes this opportunity of expressing its heartfelt appreciation to the scores of its readers that have either verbally or by letter so cordially and enthusiastically intimated their approval to the enlarged activities that were undertaken by the Journal with its last issue.

The Pacific Coast Section of N.E.L.A.

The past week has witnessed a notable event in the life of the electrical industry of the West. The Pacific Coast Section of the National Electric Light Association, formed at Los Angeles by officials of a majority of the electric light and power companies in the states of California, Arizona, Nevada and New Mexico, bids well to prove a factor of highest usefulness in bringing out an even greater economy and unified action in the electrical industry of the West.

A total capital investment of two hundred millions of dollars is involved in the membership of the new organization. With R. H. Ballard of the Southern California Edison Company heading the list of active workers in the new organization backed by a host of other well-known, influential men of the industry, it would seem that the organization should meet with enthusiastic support from its very incipiency.

The new section should not only strengthen the spirit of co-operation among the members of the national organization in this section of the country, but the harmonious evolution of Western central station problems that is bound to result should immeasurably instill into the national organization itself many new and life-giving enthusiasms.

Here in the West have arisen many engineering problems that are peculiarly our own. Men of the West have risen to manfully cope with them, and their persevering attitude has won an unusual measure of success. This new section should aid vastly in still further meeting Western needs and in advancing the electrical industry to still further usefulness in serving the need of our citizens. The Journal extends to the New Pacific Coast section of the National Electric Light Association its heartiest "bon voyage."

Electricity and Turbine in Coast Shipbuilding

Editorial reference was made in the columns of the Journal in our issue of November 25, 1916, to the splendid outlook in Pacific Coast ship building. The months that have passed since that time have begun to bear fruit in actual launching and testing of new ships that surpasses all previous expectations.

The launching of the Thordis, a seventy-one hundren ton turbine ship in the Oakland yards on January 6 and the later launching of another ship of similar tonnage, together with still another of ten thousand tons displacement on January 20th from the same ship building district, are typical of this splendid new activity all up and down the Pacific Coast.

The thing, however, that is especially pleasing to men of the electrical industry is the ever-widening sphere of activity that electricity and the steam turbine are playing.

In the former editorial attention was called to the possibility of local central loads that are to result when these ships put into port and desire to load or unload with motors receiving their driving energy from local power companies.

It is interesting also to note in passing to what gigantic widening applications the steam turbine has been put in recent months. Not only has this source of power generation practically driven its former competitor, the reciprocating engine, from the field in the modern central station, but now in combination with a reduction gear attachment it is proving itself master of the sea.

Monopoly Under Regulation

The happenings in Los Angeles during the past two weeks are of immense interest to engineers of the West.

Ever since public regulation of utility companies has been in vogue there has been constantly growing in the minds of all thoughtful investigators along these lines the conclusion that competition and regulation are two issues that are diametrically opposed the one to the other.

The main reason for this is that competition of necessity involves duplication of service and this latter feature means increased cost of production. On the other hand public regulation of a utility makes possible all the economic features of low cost of production and yet holds the earnings within reasonable bounds.

Hence the controversy in Los Angeles between the proposed advent of municipal power and the private power companies already occupying the field has been watched by all on-lookers with unusual attention.

In the final adjustment of this controversy and its various resultant ramifications it would seem that what started out to be a disastrous and bitter competitive fight is now to result in vast economic advantage for all parties to the issue.

In the first place the city of Los Angeles agrees to take over the entire distribution systems of the private company, paying therefor a price fixed by the Railroad Commission after a careful investigation of the costs involved. This will enable the power companies to dispose of their city holdings in a manner just and reasonable to the owners and at the same time provision is made whereby the city may purchase additional power from these companies as occasion may demand at a price that will net the privately-owned companies eight per cent on the investment incident to the delivery of this power.

The second rather remarkable result of the controversy is the gigantic merger that has been brought about between the Pacific Light & Power Corporation and the Southern California Edison Company. Here again is a factor that will be of immense economic importance to the future hydroelectric industry of Southern California and to the consumer.

Under public regulation it will seem that complete monopoly of the industry would be of economic advantage to both utility company and to the public at large.

This growth toward centralization of utility investment is not a local one. According to the Chief of the Forest Service, in his annual report, the merging of hydroelectric companies is going on uniformly throughout the entire West.

Since monopoly is thus advocated, it would seem common justice, if the laws of Western commonwealths are not sufficient to bring under their jurisdiction the proper regulation of publicly owned power plants upon the same basis of review that the privately owned plants must pass that enactments should be brought about to make this possible.

Under such complete supervision wherein the publicly owned and privately owned plants are regulated by the same disinterested utility commission the ideal is reached and monopoly thus becomes in truth the economic factor in utility development.

New Stave Pipe Formulas

The constant use of large quantities of wood stave pipe in the construction of hydroelectric installations in the West has necessitated the frequent use of formulas for computing the flow for a pipe of definite design. Such formulas have in the past been inaccurate and often misleading.

In Bulletin 376 of the U. S. Department of Agriculture on "The Flow of Water in Wood-Stave Pipe," a commendable innovation has been made by the government in its method of presenting experimental data and the conclusions drawn from it. This bulletin contains the results of a large number of new and carefully made experiments on the carrying capacity of wood-stave pipe as well as the data on available tests from other sources. These results were used as the basis for the development of a formula for the capacity of such pipe which differs somewhat from those previously recommended by other investigators. Before publishing these results, proofs of the bulletin were sent to a number of engineers who have been prominent in the testing of such pipe and the development of formula for its carrying capacity. Their criticisms were solicited and a number of their suggestions adopted. The bulletin as finally published contains the data and conclusions of Mr. F. C. Scobey, who conducted the experiments for the government and also the comments of Mr. Gardner S. Williams, T. A. Noble, D. C. Henny, E. A. Moritz, E. W. Schoder and L. M. Hoskins. The treatment is similar to that of papers presented before the larger engineering societies, Mr. Scobey replying to such comments in the closing discussion. A portion of the comments are critical in nature and serve to call attention to the controversies still existent among engineers as to the best form of formula for the carrying capacity of pipes. To those not closely in touch with the recent developments of such formulas, the discussions serve to give a much better perspective of the status of the subject than could be secured from a bulletin containing only the views of a single author. The engineers who supplied such discussions gratuitously are entitled to the thanks of the profession and the government is to be commended for adopting this method of treatment of a subject of this character.

PERSONALS

Geo. T. Tiffany, an electrical contractor at Stockton, has recently retired from the electrical field.

G. S. Campbell of the Truckee River General Electric Company was a recent visitor at Los Angeles.

Frank Hanish, an electrical and plumbing contractor of Roseville, Cal., was a recent visitor at San Francisco.

R. W. Turnbull, with the Portland office of the General Electric Company, is spending a few days at San Francisco.

John Stanovich of the Central Electric Company, Watsonville, California, spent New Year's day and eve in San Francisco.

W. E. Hayes, manager of the Hayes, Van Fleet Electric Company of Santa Rosa, spent a few days in San Francisco last week.

H. S. Batchelder of the Western States Gas & Electric Company of Stockton was a recent business visitor at San Francisco.

W. L. Brittle of the Western Gas & Electric Appliance Company, of Chico, was a recent business visitor at San Francisco.

W. W. Briggs of the Great Western Power Company, of San Francisco, recently returned from a few days' trip to Los Angeles.

Chauncy Carr, heating specialist of the General Electric Company of Los Angeles, was a recent business visitor at San Francisco.

T. C. Browne of the Federal Sign System (Electric) of Salt Lake City, spent a few days the latter part of the week at San Francisco.

John A. Britton, vice-president and general manager Pacific Gas & Electric Company of San Francisco was a recent visitor at Los Angeles.

W. J. Grambs, assistant to the president of the Puget Sound Traction, Light & Power Company, has returned to Seattle from a trip to California.

F. Schuyler of the Los Angeles office of the Allis-Chalmers Company, has recently been transferred to the San Francisco office where he will resume his duties.

Henry Karge of the Nevada Telephone Supply & Construction Company, Carson City, Nevada, has returned after spending two weeks' holiday vacation at San Francisco.

Chas. Davis, manager of the Boston district of the General Electric Company, recently arrived at San Francisco after an extended trip through the Orient and will continue his trip East shortly.

F. J. Verfurth, general manager of the Central California Electric Company of Lindsay, recently returned from an extended trip throughout the East, where he visited the various factories which he represents.

A. H. Halloran, vice-president and managing editor of the Journal of Electricity, is making an extended trip through Arizona in the interests of the Pacific Coast Section of the National Electric Light Association, the Society for Electrical Development and the Journal of Electricity.

L. Y. Woodmansee, formerly superintendent of generation for the Arizona Power Company at Prescott, Arizona, has been appointed electrical engineer for Electrical District No. 2, in Arizona, which irrigation district receives its supply of electrical energy from the Roosevelt Dam of the Salt River Project.

H. R. Noack, formerly president of the Pierson, Roeding Company of San Francisco, and one of the best known electrical men on the Pacific Coast, has recently accepted a position on the sales staff of the Pacific States Electric Company, with headquarters at San Francisco. Mr. Noack will have charge of the high tension transmission and pole line business of that company.

F. H. Leggett, formerly Pacific Coast manager of the Western Electric Company, was the guest of honor at a luncheon given at Tait's restaurant in San Francisco on the 29th of December. Those present who participated in this farewell party were W. S. Berry, E. J. Wallis, H. B. Squires, H. E. Sanderson, Garnett Young, S. B. Gregory, R. F. Oakes, R. M. Alvord, Carl Heise, E. M. Cutting, Walter Wurfel, R. J. Davis, J. A. Vandegrift, Walter Seaver, S. W. Gilman, Miles F. Steel.

Romaine W. Myers, a consulting engineer on electrical and illuminating problems, with headquarters in Oakland, California, has been appointed California representative of the Illuminating Engineering Society, with membership on the committees of membership and sustaining membership of that organization. Mr. Myers has also been appointed by the advertising bureau of the Oakland Chamber of Commerce to have charge of all electrical and illuminating effects at the Ad Masque Ball to be given in Oakland's new Civic Auditorium on February 14, 1917.

W. L. Goodwin, formerly Pacific Coast manager Pacific States Electric Company, who has accepted a position with the General Electric Company in Schenectady, N. Y., was the guest of honor at a farewell party on January 5th. There gathered together on the Claremont Country Club course as guests of T. E. Bibbins, all of the golfers of the electrical fraternity of San Francisco. Some good golf was played and some bad golf, but altogether a good time was enjoyed by all. In the evening all were gathered around the table for dinner, where good fellowship was shown, and regrets were expressed at Mr. Goodwin's proposed departure. During dinner Mr. C. C. Hillis, in his jovial way, expressed the sentiments of all, in presenting in the name of the Socket Club a gold watch beautifully engraved with the names of the members of the club. Those in attendance at golf and dinner were Messrs. Geo. C. Holberton, H. V. Carter, W. L. Goodwin, S. B. Anderson, H. E. Sanderson, R. J. Davis, S. B. Gregory, Roscoe Oakes, C. E. Wiggin, W. S. Berry, W. A. Blair, Garnett Young, Miles Steele, Walter Seaver, E. O. Shreve, C. C. Hillis, O. W. Lillard, F. C. Phelps, T. E. Bibbins, H. B. Squires, S. H. Taylor, D. E. Harris, Stanley Walton, R. M. Alvord.

ORGANIZATION OF PACIFIC COAST SECTION NATIONAL ELECTRIC LIGHT ASSOCIATION.

The Pacific Coast Section of the National Electric Light Association was organized at a meeting of representative electrical men held in Los Angeles on January 6th. Aside from organizing and determining to hold a convention in April, the most important business transacted was the appropriation of $500 for carrying on the investigation of insulator troubles and the request that Class D members (manufacturers, jobbers and electricians) be put on a parity with Class A members as regards voting and holding office.

The officers of the newly organized section are as follows:

President—R. H. Ballard of Los Angeles.
Vice-Presidents—H. F. Jackson of San Francisco and Samuel Kahn of Stockton, Cal.
Secretary—A. H. Halloran of San Francisco.
Treasurer—A. N. Kemp of Los Angeles.

Executive Committee.

Henry Bostwick, Pacific Gas & Electric Co., San Francisco.
W. W. Briggs, Great Western Power Co., San Francisco.
Wm. Baurhyte, Los Angeles Gas & Elec. Corp., Los Angeles.
Geo. S. Campbell, Truckee River Gen. Elec. Co., Reno, Nev.
E. R. Davis, Pacific Light & Power Corp., Los Angeles.
W. P. Southard, Albuquerque Gas, Elec. Lt. & Power Co., Albuquerque, N. M.
F. S. Viele, Prescott Gas & Electric Co., Prescott, Arizona.
A. Emory Wishon San Joaquin Light & Power Corp., Los Angeles.
A. B. West, Southern Sierras Power Co., Riverside, Cal.

President Ballard announced the appointment of a public policy committee, as follows:

John A. Britton, chairman; W. A. Brackenridge, H. H. Jones, S. M. Kennedy, A. G. Wishon.

The personnel of the engineering, commercial, accounting and membership committees will be announced later.

MEETING NOTICES.

Los Angeles Jovian Electric League.

An interesting program was given at the luncheon on January 3d. President A. E. Morphy introduced T. J. Royer, of the R. A. Rowan Company, as chairman of the day, who was followed by David A. Curry, known as the "Stentor of Yosemite." In an entertaining address on "Our National Parks" he stated that thirty-three thousand visitors journeyed to Yellowstone and predicted that this number would reach one hundred thousand for 1918.

John Topham, city councilman, also addressed the league, taking for his subject "The Trouble Shooter." The trials and tribulations of a councilman were explained in a heart to heart talk and the city's side of the power situation was also discussed.

Pleasing and entertaining vocal and instrumental numbers were rendered by Miss Spaulding.

San Francisco Electrical Development and Jovian League.

The January 3rd meeting, the first after the Christmas recess, was devoted largely to a discussion of the recent increase in the national Jovian dues. Inasmuch as the local league has been paying the national dues of its Jovian members, a corresponding increase in local dues becomes necessary. Such an increase was proposed in tentative amendments to the constitution, which were submitted for general discussion. A division of opinion at once resulted. One side, as ably represented by W. S. Berry, advocated a complete severance of national relations. T. E. Collins argued in favor of federalization. H. V. Carter suggested that the organization be conducted purely as a Jovian League. As a simple solution to the complex schedule submitted, A. H. Halloran suggested that the local dues remain as heretofore and that an extra $2.00 be collected from Jovian members next October, the league secretary also collecting the dues of all Jovians in the territory. It was indicated that a possibility existed of returning to the old basis after the meeting of the next Jovian congress. The executive committee has taken matter under advisement, and will report at a later meeting. R. M. Alvord, presiding officer, then requested E. M. Cutting to express the league's regret at F. H. Leggett's departure for New York City. Mr. Leggett responded by telling of the great pleasure and benefit he had derived from association with the league members, and shook hands with all members after the meeting adjourned.

ELECTRICAL ENGINEERS MEET IN PITTSBURGH TO DISCUSS IMPORTANT QUESTION.

The American Institute of Electrical Engineers held its last meeting in Pittsburgh on January 12, 1917, with headquarters at the Fort Pitt Hotel.

Following the policy adopted a short time ago, the Institute, instead of confining its session to one annual meeting during the year, has decided to hold several meetings at stated intervals in various parts of the country.

The Pittsburgh meeting was devoted to a discussion of "Braking Electric Vehicles by Regeneration," using the energy generated on down grades to apply brakes to the vehicles.

The paper on this subject was presented by Mr. R. E. Hellmund of the Westinghouse Electric & Mfg. Company. The meeting will be presided over by Mr. Harold W. Buck, of New York City, president of the Institute.

NOTES ON UTILITIES COMMISSION OF IDAHO.

In the matter of the filing of annual reports under Section 27 of the Public Utilities Act, the commission has ordered, that all public utilities operating within the state of Idaho which are subject to the provisions of the Public Utilities Act be required hereafter to file in the office of the commission on or before the thirtieth day of September in each year, reports covering the period of twelve months ending with the thirty-first day of December preceding said date, giving the particulars called for in the annual reports required by the commission; provided, that as to all public utilities which are not required to file annual reports with the Interstate Commerce Commission in conformity with the order of the Interstate Commerce Commission made and entered as of the twenty-fourth day of November, 1916, the report to be made for the year ending December 31, 1916, shall cover only the period from July 1, 1916, to December 31, 1916, inclusive.

In the matter of the publication and filing by each common carrier engaged in interstate commerce and operating in the state of Idaho, of a complete index of tariffs in effect and to which it is a party either as an initial or delivering carrier, the commission has ordered that each common carrier operating in the state of Idaho, who, under the regulations of the Interstate Commerce Commission as set out in Tariff Circular No. 18-A, is required to publish and file an index of tariffs in accordance with Rule 11 in said tariff circular, shall enter after each I. C. C. number in its list of the numbers of tariffs of its own I. C. C. series arranged in numerical order, its corresponding P. U. C. I. number, and shall in the same publication wherein appears the list wherein are entered said P. U. C. I. numbers as aforesaid, publish a list of the numbers of intrastate tariffs and circulars of its own P. U. C. I. numbers, and enter after each of said P. U. C. I. numbers the corresponding carrier number; provided, that the publication of the indices hereinbefore required may be made in a state supplement if the carrier so desires.

In the matter of the application of the Project Mutual Telephone & Electric Company, a corporation, for a certificate of convenience and necessity to construct and operate a telephone line within the village of Rupert and over what is known as the north side of the Minidoka Reclamation Project, in which the Mountain States Telephone & Telegraph Company, a corporation, appears as intervenor, the commission has ordered that the petition be denied.

UTILITY COMPANY NOTES.

Western States Buys Large Water Rights and Irrigating System.

Western States Gas & Electric Company, a subsidiary of the Standard Gas & Electric Company, with headquarters at Stockton, Cal., has arranged for the purchase of large water rights which will make its present water power on the American River at Placerville, Cal., a 100 per cent effective power all the year. The purchase includes the site, water and flowage rights for a 50,000 h.p. hydroelectric development. Authority for the purchase is being sought from the California Railroad Commission. The expenditure involves an outlay of approximately $190,000 and covers four large lakes, a number of minor ones, and an irrigating system in Eldorado and Amador counties. There is already an established income from the irrigating business sufficient to more than pay interest charges on the purchase price. It will more be unnecessary for the Western States Company (Stockton Division) to purchase water during drought seasons as in the past. The purchase places the company in a stronger position than ever before and gives it assurance of being able to supply all power demands for years to come.

The company's output and business are growing satisfactorily in all divisions. Gas output of the Stockton division

on December 7, 1916, amounted to 1,101,000 cu. ft., the largest in the history of the company. The output for the week ended December 7 showed an increase of 19.29 per cent over the corresponding week of last year. Part of this increase is ascribed to the large gains being made in gas heating load in response to the company's efforts along these lines. Commercially, Stockton, in common with other cities of the country, is enjoying a healthy growth. Bank clearings for the week ended December 14 amounted to $1,884,150, a gain of 55.3 per cent over the corresponding week of 1915, which places Stockton fifth in the United States in percentage of gain compared with last year.

The Richmond division of the company has secured a contract with the Standard Dredging Company for 600 h.p. in motors, covering the latter's power requirements while dredging the new Inner Harbor, which work will require about five months to complete.

Western States Gas & Electric Earnings.

Report of the Western States Gas & Electric Company for the month of November shows continued increase in both gross and net, the net increase for the month of November over November, 1915, being 14.1 per cent as compared with an increase of 4.2 per cent in the net for the year. Comparative figures follow:

Month of November:	1916.	1915.	Inc.	% Inc.
Gross earnings.....	$112,442	$106,197	$ 6,244	5.9
Net earnings	56,954	49,928	7,025	14.1
Year ended Nov. 30:				
Gross earnings.....	1,232,887	1,183,834	49,053	4.1
Net earnings	593,958	569,941	24.016	4.2

Reorganization of Northern Idaho and Montana Power Company.

Elmer Dover, president of the Northern Idaho & Montana Power Company, has been named receiver for the corporation by Judge Rudkin of the United States District Court at Spokane. It is stated that this action is preparatory to a friendly reorganization whereby the capitalization will be reduced and the company equipped with funds for the construction of immediate and future extensions. For several years the Northern Idaho & Montana Power Company has not earned its full bond interest charges, due to the failure of the communities served in Oregon, Washington, Montana and Idaho to develop in population and industries as rapidly as was expected when the original investments were made in the physical properties. The managers of the property, H. M. Byllesby & Company, have made every effort to place the company on a profitable basis without success. With the return of prosperity to the lumber industry and the resumption of agricultural development a considerable quantity of profitable new business may be obtained by making extensions which the company is unable to finance in its present condition. In order to best conserve the interests of security holders and to properly serve its field reorganization is deemed necessary by the management.

The Northern Idaho & Montana Power Company and its subsidiary, The Oregon Power Company, operate in territories with about 50,000 population, centering at Kalispell, Montana, Sandpoint, Idaho, Newport, Washington, and Albany, Eugene and Marshfield, Oregon.

ELECTRICAL IRRIGATION DISTRICT NO. 2.

A section of the Salt River Valley in Arizona lying just east of the Salt River Valley Irrigation Project, and embracing nearly 70,000 acres, underlaid with what is evidently a living lake of water at depths varying from 70 ft. to 90 ft. at different parts of the district, has recently been organized into an "Electrical District," according to the provisions of a law passed at the last session of the Arizona legislature. This district (centering around Higley, Arizona), will be known as "Electrical District No. 2," and proposes to secure power from the Roosevelt system and electrify the whole district and reclaim by pumping plants the vast acreage of fertile land it embraces. A board of seven trustees will govern the affairs of the district and they expect to be in shape in a very short time to offer bonds for sale to secure the funds for executing the work and contracts for a complete transmission, transforming and control system. L. Y. Woodmansee has been selected as secretary and engineer of the district.

TRADE NOTES.

A. J. Myers, Pacific Coast manager of the Wagner Electric Manufacturing Company, announces the change in address of that company from the Rialto Building to 159 New Montgomery street, San Francisco.

W. L. Mitick announces the change in the name of the Pacific Electric Motor Company, (Conradt Electric & Motor Company) to the Pacific Electric Motor Company, now located at 564 Eighteenth street, Oakland.

T. J. Bennett, announces the change of the name of the Rex Electric Company, formerly at Polk & Sutter streets, San Francisco, to the Rex Electric & Engineering Company, (contracting and repairing) now located at 253 Minna street.

The Federal Electric Company of 618 Mission street, San Francisco, announces its formation for the marketing of all electrical goods, except electric signs, formerly manufactured and sold by Federal Sign System (Electric) in the Pacific Coast territory. The Federal Electric Company is closely allied to Federal Sign System (Electric), which latter company will continue its activities as before concentrating on electric signs, permitting the Federal Electric Company to handle the remainder of its lines. Mr. E. A. Bullis of San Francisco is sales manager of the Federal Electric Company. Mr. T. W. Simpson, as vice-president and Western district manager of Federal Sign System (Electric) will generally supervise the activities of the newly formed Federal Electric Company.

NEW BULLETINS.

The Wagner Electric Manufacturing Company of St. Louis has just issued a fifteen page illustrated pamphlet describing a modern lumber mill with its electrical and mechanical equipment.

A new 8 page pamphlet has just been published, including descriptions and illustrations of C-H Push Sockets manufactured by The Cutler-Hammer Manufacturing Company of Milwaukee. This folder is of the type furnished to dealers and jobbers carrying imprint for distribution.

Catalog No. 8, a new 48-page booklet describing and listing C-H Push Button Specialties is now being distributed by The Cutler-Hammer Manufacturing Company of Milwaukee. This revised catalog contains 138 illustrations of sockets, switches, plugs, receptacles and other wiring devices as well as 14 diagrams of the wiring connections for the C-H automobile lighting switches. The information on C-H Push Sockets now include several new types that have been added since the previous catalog was published.

C-H electric dryers for beer vats, C-H electric industrial stoves, C-H circulation type water heaters, C-H electric plate warmers, C-H immersion type water heaters and C-H electric glue pots are described in six small envelope enclosures just issued by the Cutler-Hammer Manufacturing Company of Milwaukee. Uniformly distributed and accurately controlled heat, which is not affected by drafts of air and a heater without dirt, soot or ashes, and which does not vitiate the air or overheat the room, the some of the advantages of the electric devices over the gas and oil appliances which they replace.

LATEST IN EVERYTHING ELECTRICAL

(New ideas in electrical design and method of handling business affairs of the industry are constantly arising. In this issue our readers will find new ideas for individual control for candle fixtures, a new electric soldering iron, a new heater unit, and the latest product in the electrical supply year book. Watch for the new ideas that will be presented in our next issue.—The Editor.)

NEW BRYANT SOCKETS PROVIDING INDIVIDUAL CONTROL FOR CANDLE FIXTURES.

Various efforts have been made from time to time to provide individual control for candle fixtures without destroying the symmetry of appearance or the rigidity of construction of the fixture.

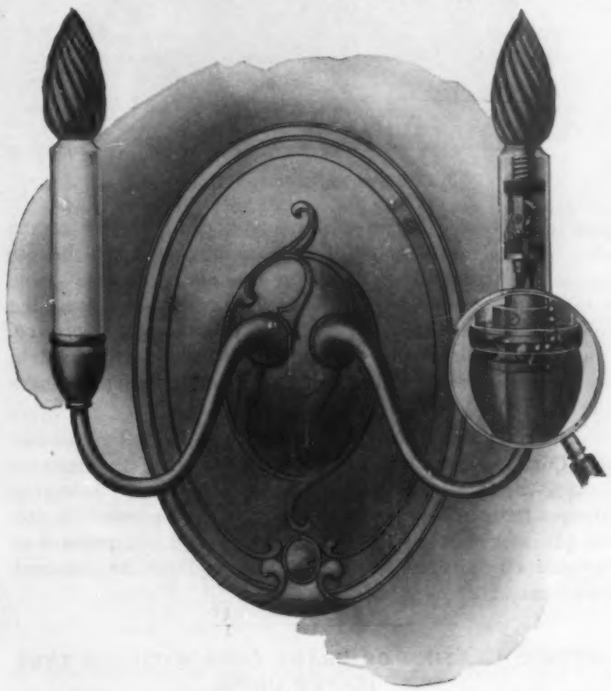
In the Bryant medium and candelabra base, candle "pull" and "turn" sockets, however, as will be noted from the detail views, these two ideas have been fulfilled. In both devices the substantially designed operating mechanism is rigidly fastened near the top of the candle. By this arrangement advantage is taken of space within the candle which has heretofore been wasted, and ready access is provided to the binding screws for wiring. Because the mechanism and parts are not crowded together, the danger of short circuit is practically entirely eliminated. Furthermore, the arrangement of the mechanism lends itself to practically any design of fixture, as the bobeche may be made as small as might be desired, while the cup may be liberally proportioned without interfering in any way with the perfectly satisfactory operation of the switch. As will be noted from the illustrations, the chains from the pull sockets, catalog numbers 540 and 4120, hang perpendicularly in the candles and are carried through very small holes in the bobeche and candle cups, leaving only enough chain extending from the bottom of the fixtures to permit of easy location and operation of same.

Bryant Candelabra Pull Socket. (No. 540).

Medium-Base Candle Pull Socket (No. 4120.)

In the "turn" devices, catalog numbers 560 and 4121, two circular superimposed discs are provided. These two discs, in addition to the sockets, numbers 540 and 4120, can be inserted in any fixture by firmly fastening the upper one to the pipe stem with the lower disc securely fastened in the bobeche or candle cup. The rotation of the latter, in either direction, will pull the chain down sufficiently to operate the socket. In this way the entire operating mechanism is completely hidden from view and the very daintiest candle fixtures can be made up with individual control lights. It will be noted that the bead chains are provided with a splicing link close to fixture proper, which permits fixture manufacturer to disconnect the lower exposed portion of chain for special finishing to match balance of fixture.

In the medium base device, the mechanism is firmly supported within a liberally designed molded insulation block of non-breakable material instead of the old style porcelain block, while the candelabra base is supported by three heavy brass "legs" which absolutely prevent any side-play, even when the pull chain is actuated by a sudden jerk. The switch mechanism consists of a thick insulated disc with pall spring and ratchet contact and escapement. Another feature worthy of note to the fixture manufacturer is that these sockets fit inside standard porcelain and fibre candles.



Candelabra Turn Socket (No. 560) with Enlarged View showing Detail.

FINAL DECREE IN GENERAL ELECTRIC COMPANY TUNGSTEN LAMP CASE.

Final decree was entered November 15, 1916, in the suit of the General Electric Company against the Laco-Philips Company of New York for infringement of the Just and Hanamann tungsten filament lamp patents. Payment was made to the General Electric Company of approximately $95,000 on account of damages for infringement of this patent.

The bill of complaint in the case was filed by the General Electric Company in 1912. The suit was argued in the District Court, Southern District, of New York, November, 1915. Judge Mayer decided in favor of the General Electric Company in February, 1916. The case was appealed by the defendant and argued in the United States Circuit Court of Appeals in New York last May. This court affirmed Judge Mayer's opinion in June and final decree was entered November 15, 1916.

NEW C-H ELECTRIC SOLDERING IRON.

The electric heating unit of a new type of electric soldering iron is hermetically sealed inside the body of the iron. This prevents moisture, heated solder or flux from penetrating a joint and coming in contact with the heater wire. The

The Electric Soldering Iron.

same metal,—steel, is used throughout the structure of the body to eliminate the liability of opening of seams due to unequal expansion. The copper tip does not screw into a hole in the iron body but the C-H design is such that a threaded core extends from the body and over this the tip is screwed. The heated core of the body therefore passes directly into the copper tip leading the heat in and concentrating it where it is required.

Five standard sizes are made by The Cutler-Hammer Mfg. Company of Milwaukee. The sizes vary in diameter from 5/8 in. to 1¾ in. Besides being used for all soldering purposes they may be used for melting wax, for branding, etc. The advantages of cleanliness, efficiency and convenience of electric soldering irons are well known and further comment is unnecessary.

ELECTRIC HEATING OF CRANE CABS WITH C-H TYPE "H" HEATER UNITS.

After the first of November the cabs of outdoor cranes usually become uncomfortable for the operator because of the cold. Various methods of heating these cabs are in use, but nothing entirely successful from all standpoints has been developed. Space is at a premium and for this reason grid resistance banks, because of their dimensions, are usually unsuitable. The Cutler-Hammer Manufacturing Company, of Milwaukee, has been adapting its Type H enclosed steel-jacketed heater unit for many industrial heating applications, including the heating of crane cabs. Such men as crane operators, and shearmen and tablemen in steel plants can keep their bodies properly clothed and warm, but the feet will get cold in most cases. By supporting a heavy, perforated metal plate about two inches from the floor and placing these flat H units in the air space between the plate and the floor, a warm air current will circulate up through the perforations. Additional units may be distributed at other points for raising the temperature to a comfortable degree, a minimum of space being required. The units have a capacity of 500 watts, and can be used on either direct or alternating systems. They are 1½ in. wide, 3/16 in. deep and 2 ft. long, just like a flat ruler. They require no assembly of parts and can be installed singly or in groups connected in multiple, like so many lamps. All parts being enclosed, they are not easily damaged by mechanical abuse or vibrations. The steel jacket entirely encloses the nickel chromium resistor, which is in turn enclosed in mica.

Insulated eyelet terminals are provided for mounting. Standard units are made for 115, 230 and 250 volt circuits.

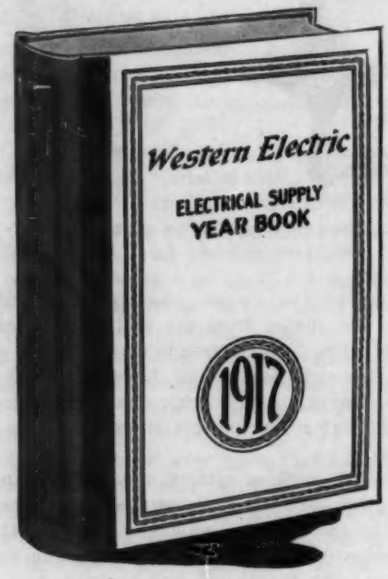
Steel-Jacketed Electric Heater Unit.

They eliminate the fire hazard and the resistor being doubly insulated, there is no chance of grounds. In mounting only sufficient clear space need be provided to permit free movement of air.

NEW ELECTRICAL SUPPLY BOOK.

Much study has been given to the proper manner of presenting to the trade a complete list of electrical supplies and equipment carried by the large houses. The last word in efficient presentation of such matter has this year been brought out by the Western Electric Company.

In January, 1915, the Western Electric Company brought out its first issue of the Year Book, which superseded its general catalog, and in 1916 the second issue came out. The method of bringing out a Year Book and thus giving up-to-



New Electrical Supply Book.

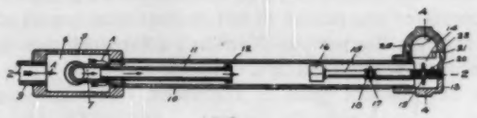
the-minute information has grown to be quite popular with the purchasers of electrical supplies and equipment. The uniform list with one basic discount is also another popular feature. The 1917 Year Book is now ready for distribution to the trade.

WHAT WESTERN INVENTORS ARE DOING

(It is interesting to note in passing that the typical Western inventions listed below, patents for which have been just granted, set forth ideas of fuel oil economy, electric heating and control that are largely occupying the thought of the electrical fraternity as a whole at the present time.—The Editor.)

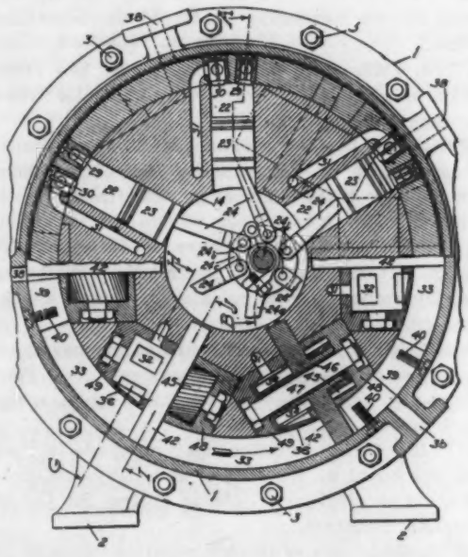
1,209,566. **Oil Burner.** Edward William Discher, Seattle, Washington.

An oil burner comprising a burner pipe provided with vapor and oil inlet means, a nozzle on the end of said pipe, said nozzle having a cylindrical chamber and a horizontally disposed fuel discharge slot, a rod secured to said nozzle and adapted to project rearwardly into said burner pipe in axial alinement therewith, washers of smaller diameter than said burner pipe adjustably secured on said rod within said burner pipe and a washer of substantially the same diameter as said burner pipe adjustably secured on said rod within said nozzle.



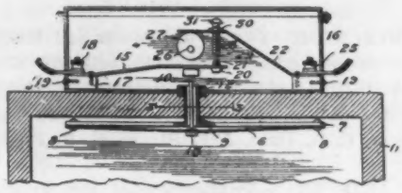
1,209,067. **Rotary Internal Combustion Engine.** William M. Sublette, San Jose, California.

A rotary internal combustion engine, comprising a metal body outer casing cast in two pieces, having metal supports which are an integral part thereof, means by which said two pieces are fastened together, main projections, which are an integral part of said outer casing, adapted to retain bearings therein, a flange and means of fastening said flange to one of said main projections, a crank shaft having a plurality of cranks forming said crank shaft, one end of said crank shaft being square, said flange being adapted to engage the square end of said crank shaft and hold the same rigid, means for connecting a carburetor to the end of said crank shaft, means by which the mixture of air and gas is admitted through said crank shaft, substantially as shown and described.



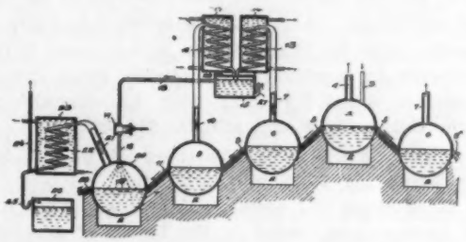
1,209,234. **Thermostatic Controller for Electrically Heated Devices.** Clarence Truitt, Pomona, California.

A thermostatic controller for electrically heated devices, a thermostat, a plurality of resilient contact carriers, each of said carriers being provided with an adjustable and removable contact element, one of said contact elements being oppositely positioned to another of said elements, and rotatable means interposed between said carriers to limit the movement and vary the position of one of said carriers.



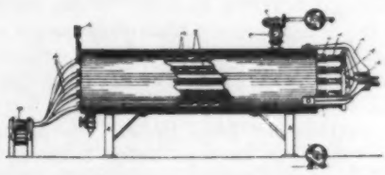
1,208,214. **Apparatus for Converting the Heavy Products Obtained From Petroleum.** Pedro Roth and Maximo Eduardo Venturino, Buenos Aires, Argentina.

Apparatus for the industrial conversion of the heavy products of petroleum into lighter products, comprising in combination:—a series of boilers arranged in battery, means of connection between every two successive boilers, means for the discharge of the vapors and gases of distillation from each boiler, means for condensing said vapors and gases, means for separating the condensed heavy or middle hydrocarbons from the water and impurities which they may contain, and means for introducing said liquid heavy or middle hydrocarbons into the vapor space of the lowermost or converting boiler and means for condensing the vapors generated within said converting boiler.



1,209,619. **Automatic Continuous Cooker for Food Products in Hermetically Sealed Containers.** Edward S. Rea, San Francisco, and William S. Rea, Jr., Oakland, California.

A steam cooker for food products in hermetically sealed containers, a cylinder adapted to sustain internal pressure and provided with a suitable steam intake, a series of open tubes within said cylinder and adapted to serve as conduits for said containers during their passage through said cylinder, in combination with a time-regulated, automatic ram for advancing said containers through said tubes.



NEW ELECTRICAL DEVELOPMENTS

(The merging of the two great power companies of Southern California, the calling of a special election in Los Angeles to vote upon a twelve million dollar bond issue to perfect a municipal electric distribution district, and the continued rumor of gigantic railway electrification in the Northwest constitute the big news items of the week along electrical development lines. The formation of the new Pacific Coast section of the National Electric Light Association and the continued advance of municipal rivalry in effective lighting design and installation also are interesting items of progress. In the following lines our readers will find in detail the new electrical developments of the West since our last date of publication.—The Editor.)

INCORPORATIONS.

PHOENIX, ARIZ.—The Hydro-Power and Irrigation Company has been incorporated by F. Putzell and R. L. Osborn.

SANTA BARBARA, CAL.—Articles of incorporation have been filed for the Santa Barbara Telephone Company by O. C. Spencer, C. A. Hart, J. L. Storia, G. B. Bush and F. L. Rabe.

PORTLAND, ORE.—Publication of the brief announcement from Salem that articles of incorporation of the Santa Barbara Telephone Company of Portland, capitalized at $700,000, had been filed with the State Commissioner of Corporations, revived speculation on the probabilities of the Bell and the independent telephone systems merging in Oregon.

FINANCIAL.

CASA GRANDE, ARIZ.—City bonds for the municipal water and electric light plant have been signed and will go to Powell-Gerard Company, the buyers. It is expected the funds will be sent immediately upon receipt of bonds.

LOS ANGELES, CAL.—The Pacific Electric Railway Company invites bids for the purchase of sufficient 5 per cent bonds covered by mortgage to the Union Trust Company of San Francisco, dated March 12, 1902, to relinquish moneys now in the sinking fund amounting to $15,000.

SPOKANE, WASH.—The Northern Idaho and Montana Power Company, a $5,000,000 corporation, operating public utilities in 35 cities and towns in Montana, Idaho, Washington and Oregon, was placed in the hands of a receiver by U. S. District Judge Frank H. Rudkin. Elmer Dover of Tacoma, was appointed receiver and B. H. Grosscup of Tacoma, counsel for the receiver. The action was the result of an agreement between the company and the creditors.

ANDERSON, CAL.—According to a report of the newly appointed engineer, Thos. R. Means, to a meeting of the directors and land holders' committee of the Anderson Cottonwood Irrigation Project, it will cost $488,000 addition, to complete the system as originally proposed. The estimate of the state engineer's office, upon which the first bond issue was based, was $480,000. This amount has now been practically exhausted and the project is not yet completed. The estimate of $488,000 is in addition to the $480,000 raised by the bond issue.

SAN FRANCISCO, CAL.—According to an announcement made recently by the San Francisco-Oakland Terminal Railways, the company was unable to pay coupons of the S. F.-O. & S. J. Cons. on due dates, and will likewise be unable to pay those falling due during January. In the interests of the bondholders the company has made arrangements with several banks to purchase those coupons as their owners desire for the face value less income tax. The banks joining in this advance consist of the Anglo & London Paris National Bank, the German Savings and Loan Society, Mercantile National Bank of San Francisco, Savings Union Bank & Trust Company, Central National Bank, Oakland; the Oakland Bank of Savings and the First National Bank, Oakland.

SAN FRANCISCO, CAL.—The report of the Northwestern Electric for November and five months shows a gain of about 10 per cent for the month in net income and a gain of about 18 per cent for the period. Earnings after preferred dividend are about 2 per cent on the common stock or about 10 per cent on the market price of the stock. The statement follows:

	1916.	1915.
Gross	$76,458	$67,084
Expenses	32,701	26,443
Net	26,983	24,364
Interest	16,774	16,277
Income	26,983	24,364
Preferred dividend	8,720	.....
Surplus	18,263	.....
Five months ended November 30—		
Gross	$298,854	$263,470
Expenses	136,310	117,123
Net	161,544	146,348
Interest	82,073	80,631
Income	77,472	65,717

ILLUMINATION.

CHICO, CAL.—Bids have been called for installing an electrolier system of street lighting in this city.

PORTLAND, ORE.—The M. J. Walsh Company submitted the lowest bid for furnishing lighting fixtures for the Public Auditorium.

WATTS, CAL.—The board of trustees has ordered the installation of ornamental electroliers on Rosella avenue, from Shorb avenue to Main street.

BAKERSFIELD, CAL.—The council has approved the petition presented by a committee from the chamber of commerce for the installation of 240 electroliers in the business district.

RIVERSIDE, CAL.—In response to an application from residents on Rivera street, the electric line will be extended from the fair grounds across private property to reach homes on Rivera street.

SAN LEANDRO, CAL.—The board of trustees has adopted resolutions to construct a lighting system on E Fourteenth street from the center line of Thornton street across East Fourteenth street.

VENTURA, CAL.—Recommendations made in the annual report of the board of trustees of the California School for Girls calls for an electrolier lighting system for the grounds, and other improvements.

WATTS, CAL.—An ordinance ordering work to be done on Albert street from Electric boulevard to Palm avenue, consisting of the installation of ornamental electroliers, has been passed by the board of trustees.

MANILA, P. I.—A modern electric plant under the management of an industrial association appearing as "The Tacloban Electric Light & Power Plant," will soon be established in the capital of Leyte Province.

SANTA BARBARA, CAL.—Concrete standards have been adopted for the ornamental lighting system on Lower State street, between De la Guerra street and the boulevard by a majority vote of the city council.

RICHMOND, CAL.—Probabilities of electroliers on Macdonald avenue and other business streets are made possible

in a new three-year agreement which the Western States Gas & Electric Company has presented for adoption.

AUBURN, WASH.—S. Cavanaugh, owner of the Auburn gas plant, has transferred his property to a company now being incorporated under the name of the Valley Gas Company, of which Eugene Kuhn of Portland is president.

HEMET, CAL.—Business men of both Hemet and San Jacinto are urging that San Jacinto street be lighted all the way between the two cities, and it is probable that 15 or 20 incandescent lights would be ample for the purpose.

PORTLAND, ORE.—Early in February detailed plans and specifications containing an estimate of the cost of construction and maintenance of a municipal lighting plant will be brought to the attention of the council for consideration.

OLYMPIA, WASH.—The Olympia Light & Power Company has announced that a 1000 h.p. steam auxiliary power plant would be erected in the near future. The plant is to cost $40,000, and the company is planning to sell stock to that amount.

SOUTH PASADENA, CAL.—At a meeting of the city council bids were received for the ornamental lighting system on Mission street, from Fair Oaks avenue to Meridian avenue. The California-Arizona Construction Company's bid of $4895 was accepted.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has awarded the contract to the Southern California Edison Company to install the electric lighting system for the elevated railway at the rear of the Main street station. Consideration, $1410.

LOS ANGELES, CAL.—At a meeting of the board of supervisors a request of the lighting committees of the Palm lighting district for furnishing lamps, glass balls, etc., for an ornamental lighting system was referred to the chief mechanical engineer for recommendation.

FLORENCE, ARIZ.—R. G. Arthur, general manager of the Douglas Investment Company, of which the Florence Improvement Company is subsidiary, states that the company has practically decided to go no further with a franchise for water and electric light systems in Florence.

CORONADO, CAL.—The proposal to install ornamental light posts on Glorietta boulevard, with underground wiring, was discussed at a meeting of the city trustees. Estimates were submitted by the city engineer for the work, as follows: 18 posts, $540; 9000 ft. wiring, $3150; total, $3690.

SAN BERNARDINO, CAL.—That San Bernardino and other valley cities can secure natural gas is the decision of a special committee. It is hoped to obtain the gas from the Fullerton fields. Large pipe lines have already been extended to within a few miles of Pomona and it is expected that city will be furnished with natural gas within a short time.

SANTA BARBARA, CAL.—There is now a reasonable certainty that the installation of ornamental lights on State street shall proceed. Plans and specifications with map and resolution of intention have been adopted by the city council. This provides for extending of metal standards on State to Sala, and concrete from De la Guerra to the boulevard.

LOS ANGELES, CAL.—It has been announced that research work in making the survey of the underground duct facilities of roadway necessary in connection with the new plans for installing an ornamental lighting system for roadway, has been completed. The lighting standard to be used will be about 25 ft. high and will carry two ornamental arc lamps, equipped with the latest developments in glassware.

LOS ANGELES, CAL.—February 2nd has been decided upon as the date for the $12,000,000 power bond election. A formal resolution calling the election will be adopted later and also the proposed contract between the city and the Southern California Edison Company and the Pacific Light & Power Corporation. The power election on the issuance of $12,000,000 bonds for a municipal power system must be held February 2, independently of the county flood control bond election. This was the unanimous declaration of the city council when a consolidation of the two elections was proposed.

TRANSMISSION.

ELSINORE, CAL.—The Southern Sierras Power Company has extended its lines in Cottonwood canyon and, it is reported, will also extend them from Alberhill to Corona.

AUSTIN, NEV.—Elmer Berg has gone to San Francisco where he will purchase all the material necessary for the electric light plant that his firm will install in this town before the coming spring.

NEWPORT, WASH.—The northern Idaho & Montana Power Company, Ltd., has filed a petition with the county commissioners of Pend Oreille county, Washington, asking for a franchise to erect a line for the transmission of electricity.

CASHMERE, WASH.—The committee on the contract for the power with the Wenatchee Valley Gas & Electric Company has under consideration the contract, also the proposition of installing an electric generating plant. They will report in the near future.

KENDRICK, IDAHO.—The county commissioners have granted a franchise to the Potlatch Consolidated Electric Company, giving the company the right to construct and maintain an electric line for the transmission of power on the highways of the county.

SALEM, ORE.—The real estate and water power of the Salem Flouring Mills Company, known as the south mill site, has been purchased by A. N. Bush. Mr. Bush states that he purchased the power site in order to utilize the power for an industry which he will inaugurate in this city.

LOS ANGELES, CAL.—Formal approval of the Public Service Commission has been given to the contract with the American Insulated Wire & Cable Company, whereby that concern is to furnish for use of the municipal power transmission line $165,000 worth of insulated cable.

RICHMOND, CAL.—It is rumored that as soon as the weather will permit in the spring the Great Western Power Company will begin the construction of a high tension power line from an intersection with its 110,000 volt line through Moraga valley out through Morago and down San Pablo Creek to Richmond to connect with a line built westward from Crockett.

MESA, ARIZ.—At a meeting of the city council it was decided to put up to the voters the question of the purchase of the entire plant of the Southside Gas & Electric Light Company. The proposition to be submitted is that the city pay $113,000 for the plant and extensions, the company to pay the cost of the election. The company will hold a meeting in a few days to pass upon the offer of the council.

TELEPHONE AND TELEGRAPH.

CLOVIS, N. M.—It is understood that several of the nearby Texas towns have opened negotiations for telephone lines connecting them with the Clovis territory.

OKANOGAN, WASH.—C. A. Blatt of Nelson, Wash., has applied to the board of commissioners of Okanogan county for a franchise to construct telephone lines upon the county roads.

SPOKANE, WASH.—Improvements aggregating $13,180 have been authorized in the telephone service in Spokane and the Inland Empire, according to an announcement of C. E. Hickman, division commercial superintendent.

DUNCAN, ARIZ.—J. E. Allen and E. M. Luckie, owners of the Duncan telephone system, have arranged for the installation of a telephone line between here and Steeplerock. Work of installation will be commenced at an early date.

CASA GRANDE, ARIZ.—The common council has passed an ordinance granting to the Mountain States Telephone & Telegraph Company a franchise for the erection, operation and maintenance of wires, cables, etc., for a telephone system.

QUINCY, CAL.—J. E. Sutherland, manager of the Pacific Telephone & Telegraph Company in this district, states that M. E. Elcott has started surveying for the new lines to be installed between Quincy and Reno and Quincy and Beckwith.

RIVERSIDE, CAL.—Active work on the consolidation of the Home telephone system of this city with the Pacific system has begun. The switchboard of the Pacific plant will be enlarged and the Home exchange will also be somewhat altered.

SAN FRANCISCO, CAL.—H. C. Chase, for several years district superintendent for the Western Union Telegraph Company, has gone to Topeka, where he will fill the position of general superintendent of the telegraph department of the Santa Fe system.

SILVER CITY, N. M.—The electrical engineer for the government has been at Ft. Bayard inspecting the telephone and telegraph system there. Extensive changes are to be made in the service. The engineer has gone to Fort Bliss to inspect the service there.

LOS ANGELES, CAL.—The city council has notified the Postal Telegraph Cable Company that it would have to file a new petition for a franchise to erect poles and wires in the streets of the city, which will give the city the right to use the poles for municipal wires.

SANTA BARBARA, CAL.—April 1 is the tentative date for the completion of the consolidation of the city and county's two telephone systems into a single system under the name of the Santa Barbara Telephone Company. Plans for construction work have been delayed due to difficulty of obtaining materials and mechanical equipment.

TRANSPORTATION.

SAN DIEGO, CAL.—An amended franchise has been granted to the La Jolla Railroad by the city council, allowing it to use gasoline-propelled cars in the city proper and in La Jolla. The charter granted in 1914 allowed the company to use electricity and the amended instrument permits the use of either or both.

SACRAMENTO, CAL.—An ordinance granting the Northern Electric Company a single track franchise along Thirty-first street was presented to the city commission by Commissioner of Street M. J. Burke. The company, under the former franchise had the right to a single or double track franchise, and when the ordinance is adopted by the commission the franchise at once becomes a single track privilege.

SEATTLE, WASH.—The Great Northern Railway Company is contemplating the expenditure of several million dollars next year in improvement work in the state. Plans are now definitely under way in the St. Paul office for the proposed 120,000 h.p. power plant at Lake Chelan which will generate the energy for electrifying the Cascade division to cost $5,000,000. A joint depot by the Great Northern and Northern Pacific will be built at Spokane to cost $300,000. Plans for terminals at Leavenworth have been completed. Double tracking will be laid between Cutbank and Shelby, Java and Essex, and Columbia Falls and Whitefish, 34 miles.

IRRIGATION.

TURLOCK, CAL.—Gasoline engines will be displaced shortly by electric power as a medium for pumping water for irrigation purposes here.

LOS ANGELES, CAL.—Bids will be received by the United States Reclamation Service for furnishing nine pairs of cast iron skew bevel gears for gate stands for the Rio Grande project, New Mexico.

SAN LUIS OBISPO, CAL.—Land owners of the Tracy irrigation district have declared themselves in favor of the $295,000 bond issue and carried the proposition by a vote of 3 to 1. Construction work will start at once.

WILLOWS, CAL.—The Sacramento Valley Colony Company, whose lands are in the north end of the county, is planning big developments. L. D. Cutler, manager, says 70 pumping plants, electrically driven, will be installed on the lands to furnish irrigation.

CATHLAMET, WASH.—At a recent meeting of the county commissioners a petition praying for the formation of a diking district was presented by the owners of the large tract of tidelands between this place and Skamokawa. This project consists of 3500 acres of valuable land.

GRASS VALLEY, CAL.—Rufus Rockwell Wilson is here in the interest of the thousand-acre tract of land which he controls in the Banner section. It is understood that Mr. Wilson is contemplating placing irrigation water upon the land. The tract will eventually be improved and subdivided.

CHICO, CAL.—The engineering plans of G. I. E. Goodner for the Paradise irrigation district have been approved by State Engineer McClure, according to word received by directors of the district. No alterations were made in the plans. A bond election for the district will probably be called soon.

RIALTO, CAL.—At a meeting of the board of trustees the matter of the extension of the water system to close-in ranches was taken up. After lengthy discussion a committee was appointed to confer with the water company regarding the extensions, which probably will lead to some consideration of the purchase of the water system by the city.

EL CENTRO, CAL.—The application of the Imperial Irrigation District to the First National Bank at Los Angeles for a loan of $200,000 has been accepted by that institution. The loan will extend for a period of six months and is expected to carry the district through until such time as bonds will provide funds. The notes will bear 6 per cent interest.

DOYLE, CAL.—An effort will be made to obtain legislation in California and Nevada which will permit of the organization of irrigation districts which comprise land in both states. The matter is brought up by the organization of the Southern Lassen district. Elbert Howard, president; William Steffins and Herbert Smart, directors of the district, and S. T. Jeffreys, connected with the federal reclamation work in Nevada, are making efforts in this direction.

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WILLOWS, CAL.—In the Glenn-Cadora-Princeton district, which carried by a vote of 130 to 35, there are 18,000 acres, which will be watered from two pumping stations. One of these stations is to be located at Sidds Landing, the other, one mile north of Princeton. These stations will be along the River Branch Canal, which will be purchased by the district. The entire cost, including installation of pumping plants, will be about $144,000. Twenty-five miles of the Central Canal have been completed at a cost of approximately $1,000,000. Twenty-three miles still are to be completed from Stony Creek to a point about four miles north of Willows. The expenditure for the work yet to be done, it is said, will not exceed $300,000.